

NASA Technical Memorandum 104565

**Monthly Means of Selected Climate
Variables for 1985-89**

**S. Schubert, C.-Y. Wu, J. Zero,
J.-K. Schemm, C.-K. Park,
and M. Suarez**

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S. Schubert
NASA Goddard Space Flight Center
Greenbelt, Maryland

C.-Y. Wu, J. Zero, and J.-K. Schemm
General Sciences Corporation
Laurel, Maryland

C.-K. Park
Universities Space Research Association
Columbia, Maryland

M. Suarez
NASA Goddard Space Flight Center
Greenbelt, Maryland



National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

Table of Contents

	page
• Introduction	iii
• The data	iii
– ECMWF analyses	iv
– SST Anomalies	iv
– OLR Anomalies	v
– Precipitation and Evapotranspiration	v
• Acknowledgements	vii
• References	ix
• Appendix: Quality Control of the ECMWF/TOGA Analyses	xi
• Monthly Means:	
• January	1
• February	31
• March	61
• April	91
• May	121
• June	151
• July	181
• August	211
• September	241
• October	271
• November	301
• December	331

1 Introduction

Meteorologists are accustomed to viewing instantaneous weather maps, since these contain the most relevant information for the task of producing short-range weather forecasts. Climatologists, on the other hand, tend to deal with long-term means, which portray the average climate. The recent emphasis on dynamical extended-range forecasting and, in particular, measuring and predicting short term climate change makes it important that we become more accustomed to looking at variations on monthly and longer time scales. The present document is meant to provide a convenient tool for researchers to familiarize themselves with the variability which occurs in selected parameters on these time scales. The format of the document has been chosen to help facilitate the intercomparison of various parameters and highlight the year-to-year variability in monthly means.

2 The Data

The data presented here are from a number of different sources. The upper air data are the European Center for Medium Range Weather Forecasts (ECMWF) uninitialized analyses. The sea surface temperature (SST) data are from the climate analysis center of the National Meteorological Center (CAC/NMC). The outgoing longwave radiation (OLR) data are from the National Oceanic and Atmospheric Administration (NOAA). The precipitation data are part of the world monthly mean surface station climatology data received from the National Center for Atmospheric Research (NCAR); the evapotranspiration calculation uses the monthly mean surface air temperature from this station data set.

The atlas is organized by month; all January fields for 1985-89 are grouped together, then February fields, and so on. Each month is divided into three groups: 1) the zonal wind and velocity potential fields, 2) the 300 mb height and the SST and OLR anomalies, and 3) the precipitation and evapotranspiration fields. Within each group, each variable always appears on the same side (odd or even) of the page to facilitate the comparison of different years.

It must be emphasized that caution should be used when interpreting the year-to-year changes, since observing system and processing changes may lead to spurious variability in the monthly means. Details of the data and calculations are given below.

2.1 ECMWF Analyses

The ECMWF data set used here is referred to in the ECMWF documentation, (ECMWF, 1989), as the "consolidated ECMWF/TOGA basic level III" data. The data were received in a packed format from ECMWF and consist of 00Z and 12Z uninitialized analyses on a 2.5 degree by 2.5 degree latitude/longitude grid beginning 1 January 1985. The data were unpacked and monthly means were computed at the 2.5 X 2.5 resolution.

In this document we present the zonal wind at 200 mb and 850 mb, the velocity potential at 200 mb and 850 mb, and the total and eddy (zonal mean removed) height field at 300 mb. In producing these monthly means we found it necessary to avoid certain time periods with bad data. These periods are indicated in the tables of the Appendix, which presents the results of a quality control analysis performed on the ECMWF/TOGA data. We have not taken into account changes in the assimilation system, which may introduce spurious "climate change" in the analyses. Of the fields shown here, the velocity potential appears to be most sensitive to such system changes (Arpe, 1990).

One further note regarding the ECMWF/TOGA data. Due to a post processing error, the wind fields provided to us for May and June of 1985 were incorrect. For this atlas, we have replaced the zonal wind and the velocity potential derived from the winds for these two months with those from the ECMWF/WMO analyses. The main difference between the WMO and TOGA data sets is that the WMO data are initialized. The zonal wind and velocity potential maps based on the WMO data are clearly labeled to indicate they are from the initialized fields.

2.2 SST Anomalies

The SST data are the global analyses of monthly means received from CAC/NMC on a two-degree grid. The analysis blends *in situ* (ship and buoy) data and satellite observations as described in Reynolds (1988). In the blended analysis, the satellite data are used to help define the shape of the fields in regions of little or no *in situ* observations. The anomalies were computed with respect to the 1950-79 climatology produced by Reynolds and Roberts (1987). The SST climatology is based on the Comprehensive Ocean-Atmosphere Data Set (COADS) described by Slutz *et al.* (1985); the climatology also uses sea ice information, and blends satellite SST observations with the *in situ* observations in data sparse regions.

Both the monthly SST and the climatology were interpolated to a 4°X5° lat-

itude/longitude grid using an area-weighting scheme. The figures show the SST anomalies between 60°N and 40°S. Outside this latitude band the *in situ* data is very sparse. The contour interval is 0.5°C. The solid contours denote positive values, zero values are denoted by the heavy contour, and the dashed lines denote negative values. The shading indicates absolute values larger than 1°C.

2.3 OLR Anomalies

The OLR data, which were kindly provided by K.-M. Lau, are from NOAA polar orbiting satellites on a 2.5°X2.5° grid (Gruber and Winston, 1978). The nighttime and daytime OLR values were averaged to obtain the monthly means and linearly interpolated to a 4°X5° latitude/longitude grid. The monthly climatology was computed for each calendar month based on the monthly means from June 1974 to May 1990. No data are available for March 1978 through December 1978, most of November 1988, and March and April, 1989. The monthly anomalies at each grid point were obtained by subtracting the climatology of the corresponding month. The impact of satellite changes and data processing techniques on the quality of the OLR data are discussed in Hurrell and Cambell (1992) and references therein.

The figures show the OLR anomalies for the latitudinal belt between 40°N and 40°S. The contour interval is 10 W/m². The heavy contour is the zero line. Dashed contours indicate negative values. Anomalies with absolute values greater than 10 W/m² are shaded. As a result of gaps in the data record, the November 1988, and the March and April 1989 means are not included.

2.4 Precipitation and Evapotranspiration Fields

The monthly mean precipitation and surface air temperature data used in the computation of the evapotranspiration are a subset of the the world monthly surface station climatology data received from W. Spangler and R. Jenne at the National Center for Atmospheric Research (NCAR). Most of the data are from the National Climate Data Center (NCDC). See Spangler and Jenne (1990) for additional information on data sources and characteristics.

At each station, the evapotranspiration (E) was determined from

$$E = \beta E_p. \quad (1)$$

The potential evaporation, E_p , was computed from (Thornthwaite, 1948):

$$E_p = \begin{cases} 0, & \text{if } T_a < 0^\circ C \\ 16L(10T_a/I)^b, & \text{if } 0 \leq T_a < 26.5^\circ C \\ -415.85 + 32.25T_a - 0.43T_a^2, & \text{if } T_a > 26.5^\circ C, \end{cases} \quad (2)$$

where

$$I = \sum_{m=1}^{12} (T_{a_m}/5)^{1.514}, \quad (3)$$

$$b = (6.75 \times 10^{-7} I^3) - (7.71 \times 10^{-5} I^2) + (1.79 \times 10^{-2} I) + 0.49, \quad (4)$$

and

$$L = (D/30)(h/12). \quad (5)$$

Here D is the number of days in the month, h is the number of hours of daylight, and T_{a_m} is the monthly mean surface air temperature for month m . Following Mintz and Serafini (1984),

$$\beta = 1 - \exp(-6.8 \frac{W}{W^*}), \quad (6)$$

where W is the soil moisture and W^* is assumed to be a constant equal to 150 mm. The soil moisture is determined by substituting (1), (2) and (6) into

$$\frac{\partial W}{\partial t} = P - E, \quad (7)$$

where P is the monthly mean precipitation.

Mintz and Serafini (1984) were primarily concerned with the *climatological* distributions of W and E . They developed an iterative method for solving (7) using monthly mean precipitation and surface temperature climatologies. In the present case, the monthly mean evapotranspiration are required for each year. After substituting (1), (2) and (6) into (7), an analytic solution for W was obtained in terms of each year's monthly mean precipitation and surface air temperature fields. As in Mintz and Serafini, runoff was accounted for by never allowing W to exceed W^* . Stations with fewer than 6 months of data were not used; however, very few stations had less than 10 months of data per year. The solution to (7) was computed in one year segments. For each year, the soil moisture was allowed two months of "spin-up" time by starting the integration at the beginning of November of the previous year. Experimentation with the initial conditions showed that

after two months of integration the results were essentially independent of the initial conditions. For convenience, the initial conditions for W were taken as the November climatological soil moisture values of Mintz and Serafini. The solution was restarted with climatological soil moisture values after periods with missing data. Finally, E was computed using (1) and (6). Further details of the calculation are given in Schemm et al. (1992).

The station values of precipitation and evapotranspiration were interpolated to a $2^\circ \times 2.5^\circ$ latitude/longitude grid. The interpolation was done by averaging station values within a 300 km radius of each grid point. The averaging weights are proportional to the inverse of the square of the distance to the station. The value at a grid point was set to undefined (indicated by hatching in the figures) if there were no stations within the 300 km radius. Figure 1 shows an example of the data coverage; the crosses indicate the location of stations which have 6 or more months of data for 1985. The precipitation fields are contoured at 0.5, 1, 2, 4, 8, 16 and 32 mm. The contours for the evapotranspiration fields are the same, except for the addition of the zero (heavy) contour. The shading intervals are indicated in the figures.

While the above approach to determining the evapotranspiration is quite crude, it appears to give reasonable results (see Mintz and Serafini, 1984). The empirical relationship (2) developed by Thornthwaite has been used extensively (see Mintz and Serafini, 1984 and references therein), though in at least some cases it is known to strongly underestimate the potential evapotranspiration (e.g., Sellers, 1965). The evapotranspiration fields presented here are perhaps most useful for assessing year to year variability.

Acknowledgements

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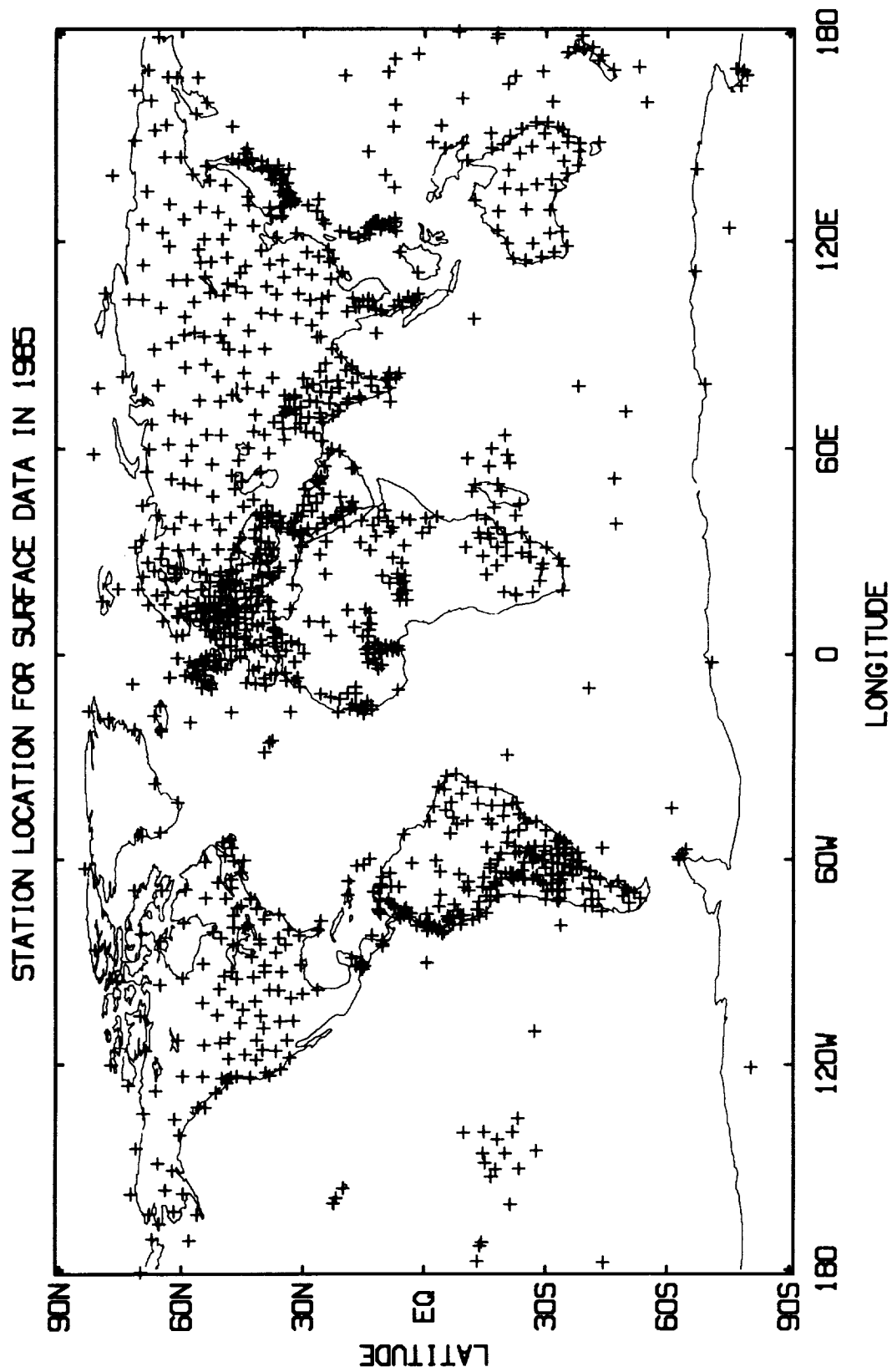


Figure 1: An example of the data coverage for the evapotranspiration calculation. The crosses indicate the location of stations which have 6 or more months of data for 1985.

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Appendix

Quality Control of the ECMWF/TOGA Analyses

For the purposes of the quality control analysis, the original data were unpacked and interpolated to a 4 degree latitude by 5 degree longitude grid. For each field (at each level) and every time period, the maximum and minimum values of the interpolated field and its tendency were computed and plotted as time series. The tendency was computed as the difference between two consecutive (00Z and 12Z) time periods. These time series were then inspected for discontinuities and other unusual behaviour. Once a suspicious time period was identified, the full two-dimensional fields were plotted to identify the nature of any data problems.

A list of the time periods with suspect data is presented in Tables 1-5 for each year. An index of 0 indicates missing data, 1 indicates suspicious data, and 2 indicates obviously bad data.

It is well known that the ECMWF data assimilation system has undergone a number of changes that have had a major impact on the character of the data (Trenberth and Olson, 1988). The present quality control analysis is not intended to specifically identify changes in the data due to changes in the ECMWF analysis system. It is meant to provide only an initial assessment of data quality using a rather coarse (global) measure to identify periods and regions with suspicious data. We appear to have been most successful in finding gross errors due to post processing and local anomalies which are likely associated with erroneous observations. Other publications that have documented and compiled ECMWF analyses include Trenberth and Olson (1988), Hoskins et. al. (1989), and Schubert et. al. (1990a and b).

In addition to the results presented in the tables, we found many other instances of suspicious behaviour in the vertical velocity and relative humidity fields. The maximum/minimum values in the relative humidity fields exhibited many instances of erratic behaviour at upper levels throughout the entire time period. An inspection of the two-dimensional fields for selected time periods exhibiting this erratic behavior did not shed much light on the problem since these were often associated with spatially localized instances of high or low relative humidity. Based on these results we decided that values above 200 hPa are probably not trustworthy—though this should be studied more carefully, since it is not clear that the behaviour of the maximum/minimum is a particularly good measure for judging the quality of the relative humidity at the upper levels. The vertical velocity field also ex-

hibited many instances of what appeared to be unrealistic localized anomalies. In particular, the region near the coasts of Argentina and Uruguay was characterized by a relatively large number of cases of unusually large vertical motion. Since there were many similar cases in many different regions of the world, and we were not able to distinguish clearly between realistic cases and those which were due to problems with the analysis, it was decided not to include these anomalies in our category of suspicious data. Further details of the quality control analysis may be found in Schubert *et. al.* (1991).

Table 1: 1985

Date	Hour	Quantity	Level	Index	Remarks
4/23	12	all	all	0	all fields set to zero
4/24	12	all	all	0	all fields set to zero
4/30	00	all	all	0	all fields set to zero
5/1-31	all	UWND	all	2	unrealistically large values near poles
					unrealistic global distribution
5/1-31	all	VWND	all	2	unrealistically large values near poles
					unrealistic global distribution
6/1-31	all	UWND	all	2	unrealistically large values near poles
					unrealistic global distribution
6/1-31	all	VWND	all	2	unrealistically large values near poles
					unrealistic global distribution
6/14	00	all	all	0	all fields set to zero
6/14	12	all	all	0	all fields set to zero
10/24	00	TMPU	1000	1	localized anomaly near (160E-135W; 90S-60S)
11/20-30	all	UWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)
11/20-30	all	VWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)
12/01-22	all	UWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)
12/01-22	all	VWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)

Table 2: 1986

Date	Hour	Quantity	Level	Index	Remarks
2/09-26	all	UWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)
2/09-26	all	VWND	10-50	1	unrealistic dipole (60E-180E; 30S-15N)
2/15-27	all	HGHT	10-50	1	localized anomaly (90E-125E; 30S-0)
3/16	12	TMPU	300	1	localized anomaly (60E-80E; 60S-45S)
3/16	12	HGHT	10-300	1	localized anomaly (60E-75E; 60S-45S)
5/04	12	TMPU	300	1	localized anomaly (150E-170E; 60S-45S)
5/04	12	HGHT	10-300	1	localized anomaly (150E-170E; 60S-40S)
5/13	00	WWND	10-100	1	less variability after 13th
5/13	00	UWND	10-50	1	large change in tropical winds on 13th
5/13	00	VWND	10-50	1	large change in tropical winds on 13th
5/13	00	TMPU	10-30	1	large change in global structure on 13th
6/14-16	all	UWND	10	1	anomaly in region (40E-80E; 45S-5S)
6/14-16	all	VWND	10	1	anomaly in region (30E-90E; 50S-10S)

Table 3: 1987

Date	Hour	Quantity	Level	Index	Remarks
2/07	12	TD2M	0	2	localized anomaly near (70W, 30S)
3/08	12	TD2M	0	2	localized anomaly near (15W, 15N)
3/11	12	TD2M	0	2	localized anomaly near (15W, 15N)
3/17	12	TD2M	0	2	localized anomaly near (40E, 30N)

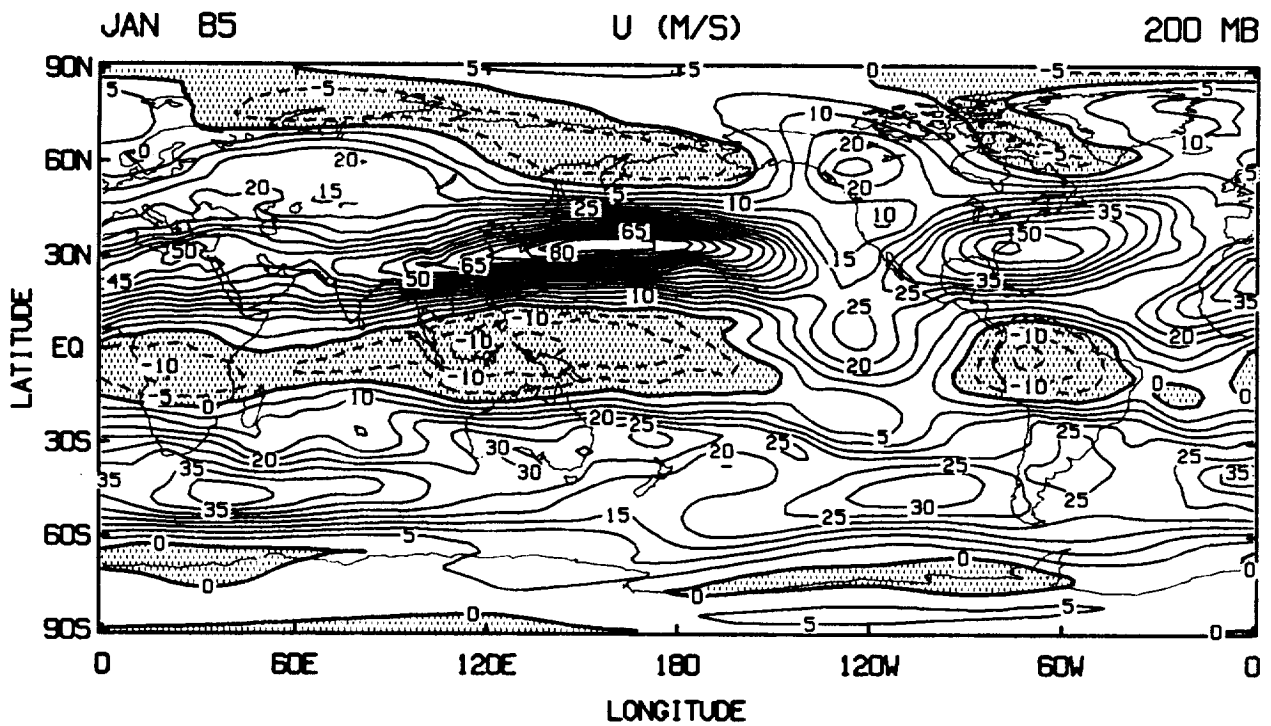
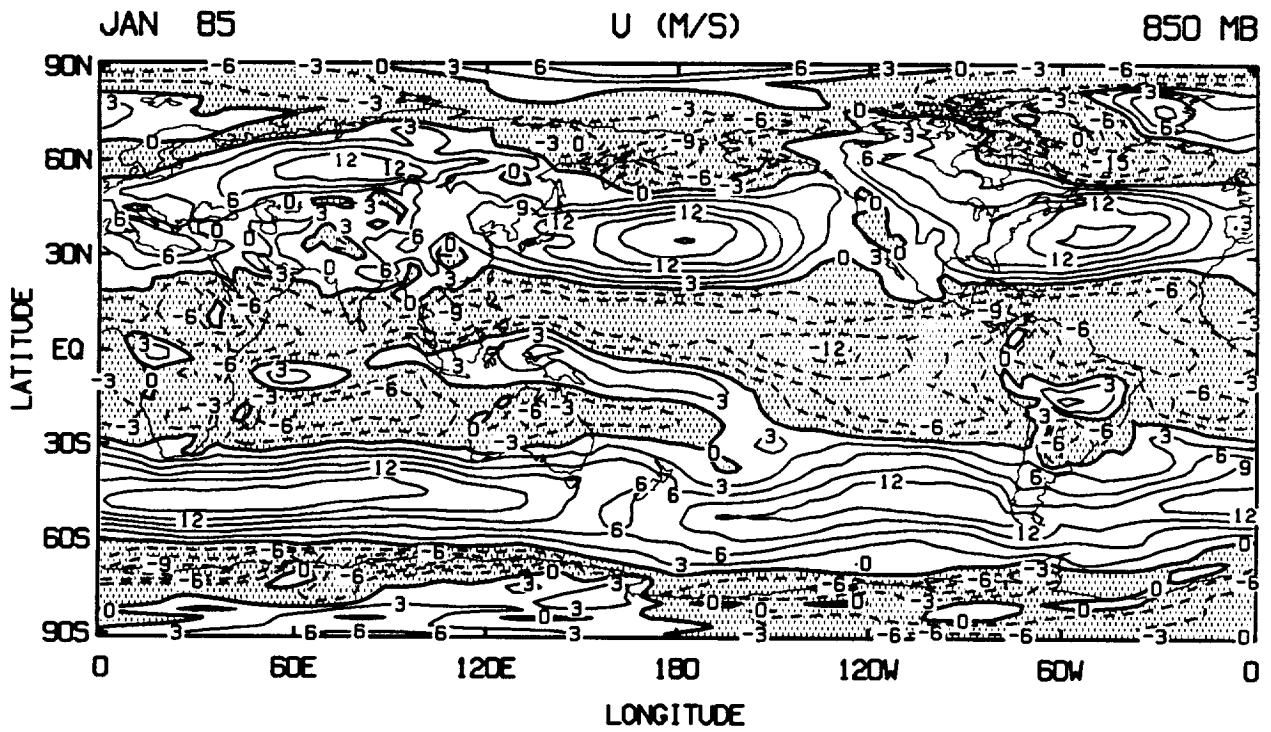
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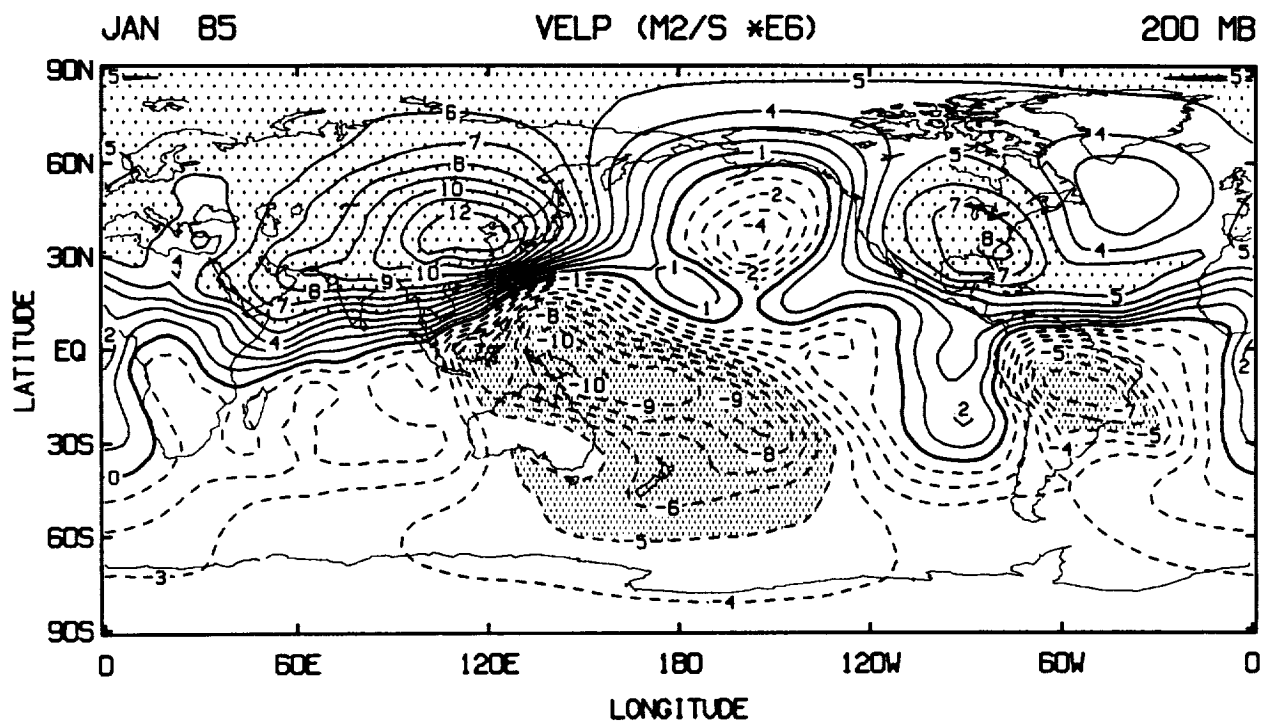
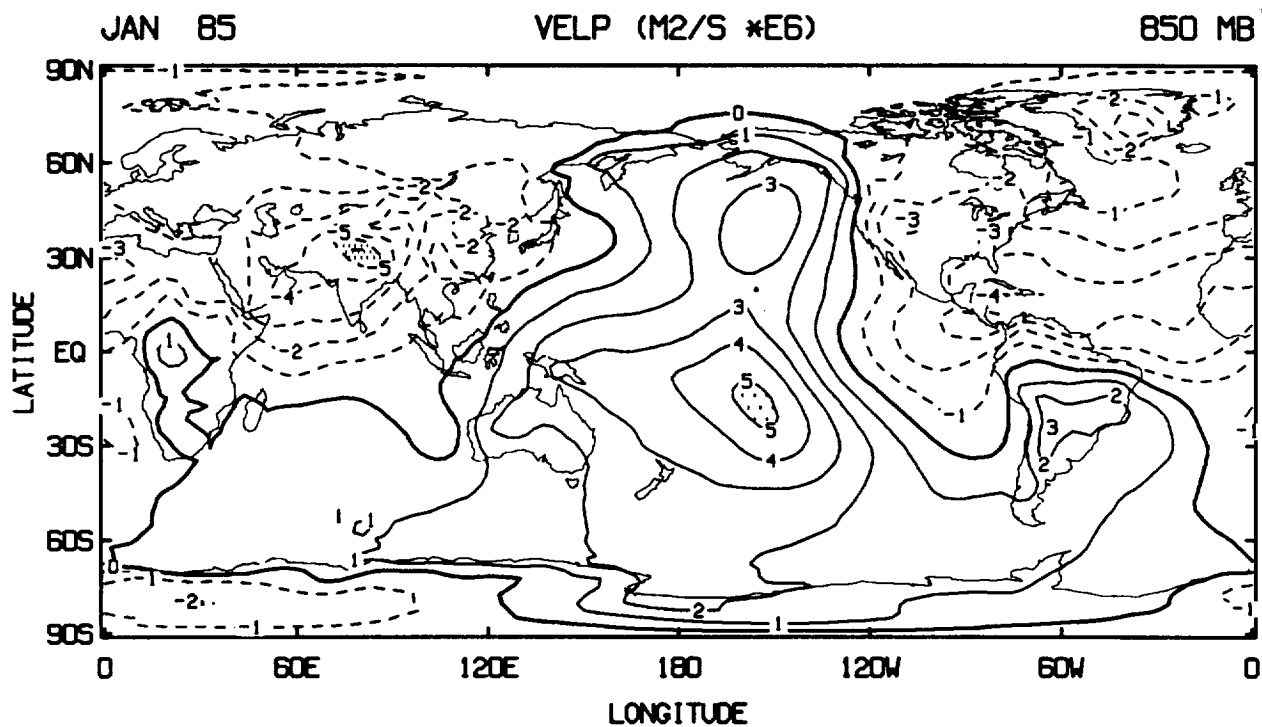
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7/22-31	all	UWND	10-50	1	unrealistic flow (eastern/southern hemisphere)
7/22-31	all	VWND	10-50	1	unrealistic flow (eastern/southern hemisphere)
7/22-31	all	TMPU	10-70	1	unrealistic flow (eastern/southern hemisphere)
7/22-31	all	HGHT	10-30	1	unrealistic flow (eastern/southern hemisphere)
8/1-2	all	WWND	10-150	1	unrealistic flow (eastern/southern hemisphere)
8/1-2	all	UWND	10-50	1	unrealistic flow (eastern/southern hemisphere)
8/1-2	all	VWND	10-50	1	unrealistic flow (eastern/southern hemisphere)
8/1-2	all	TMPU	10-70	1	unrealistic flow (eastern/southern hemisphere)
8/1-2	all	HGHT	10-30	1	unrealistic flow (eastern/southern hemisphere)

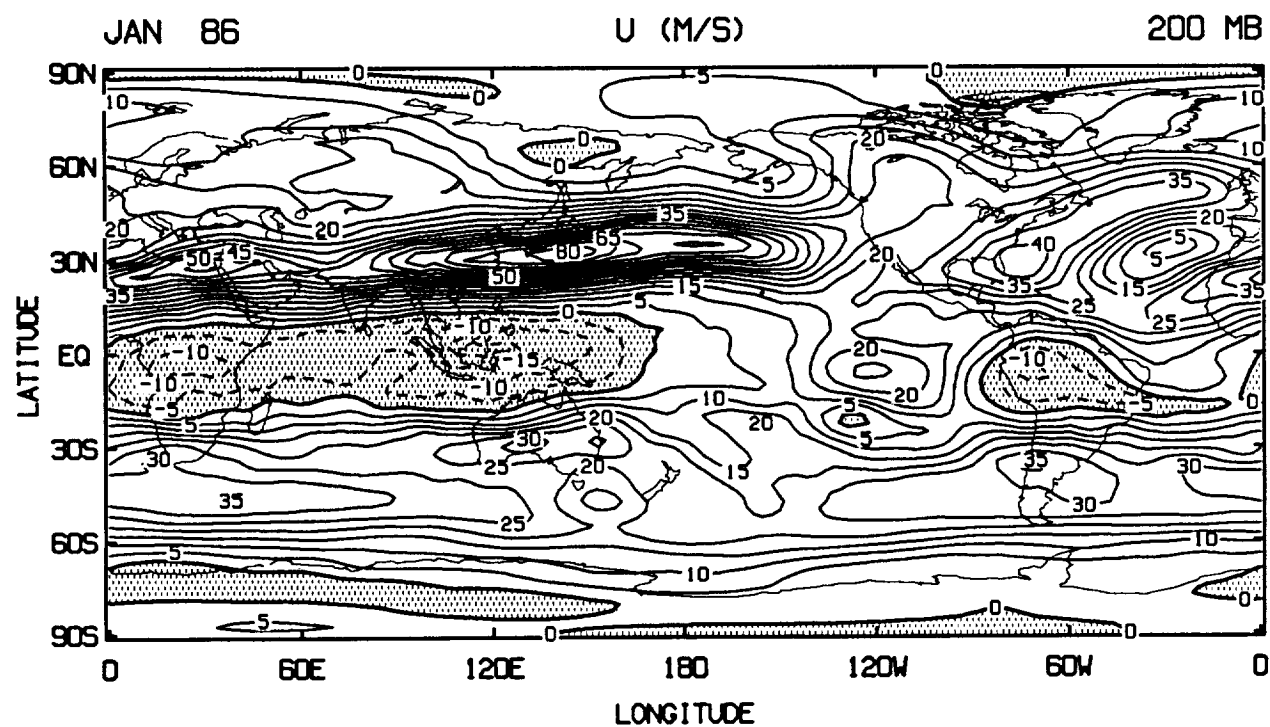
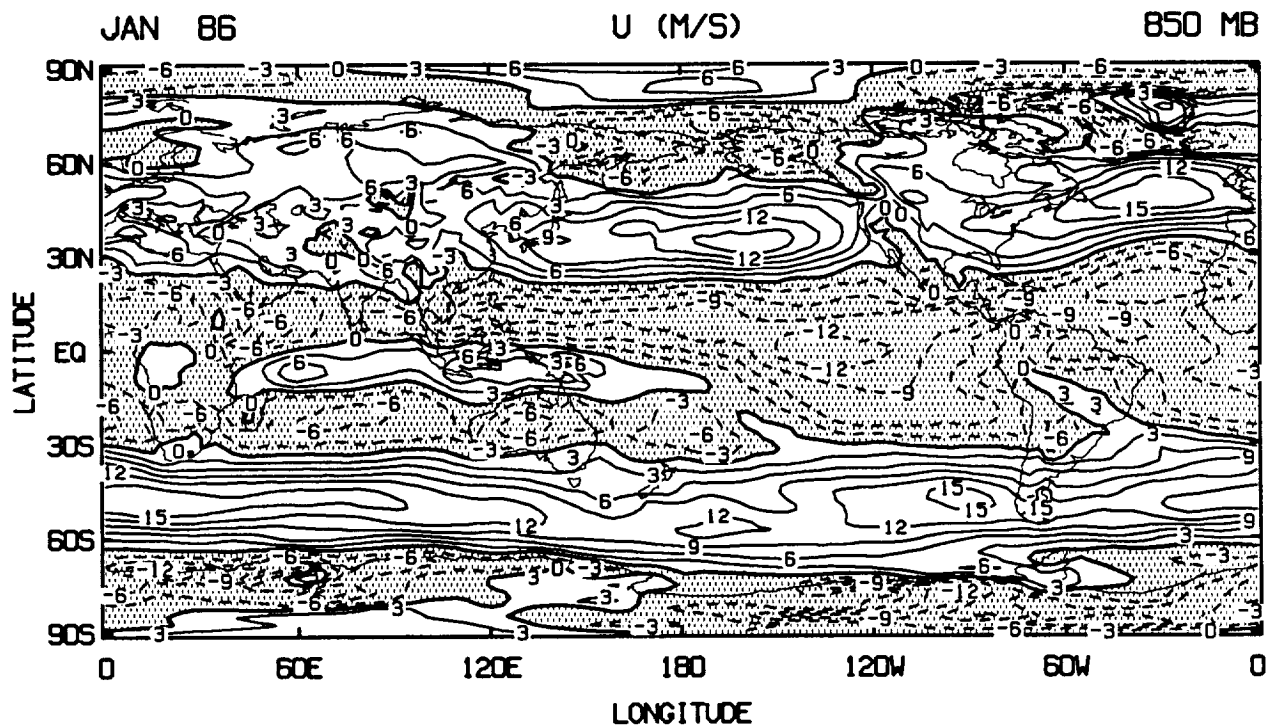
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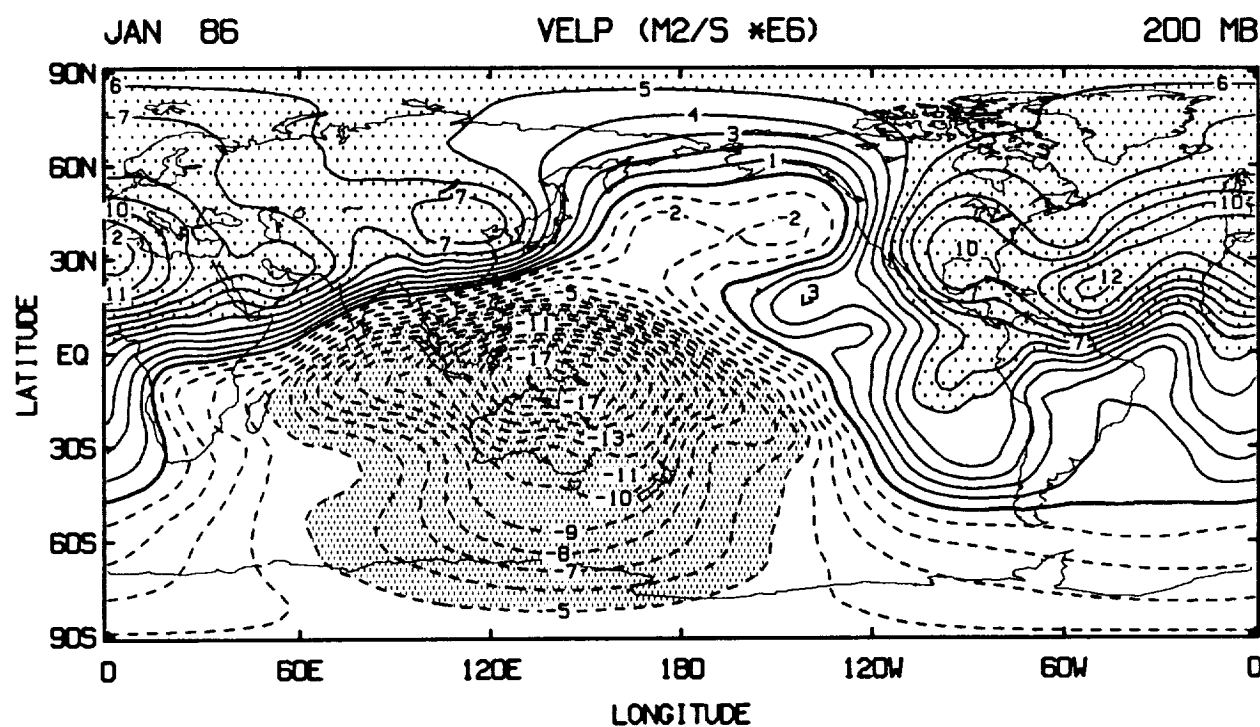
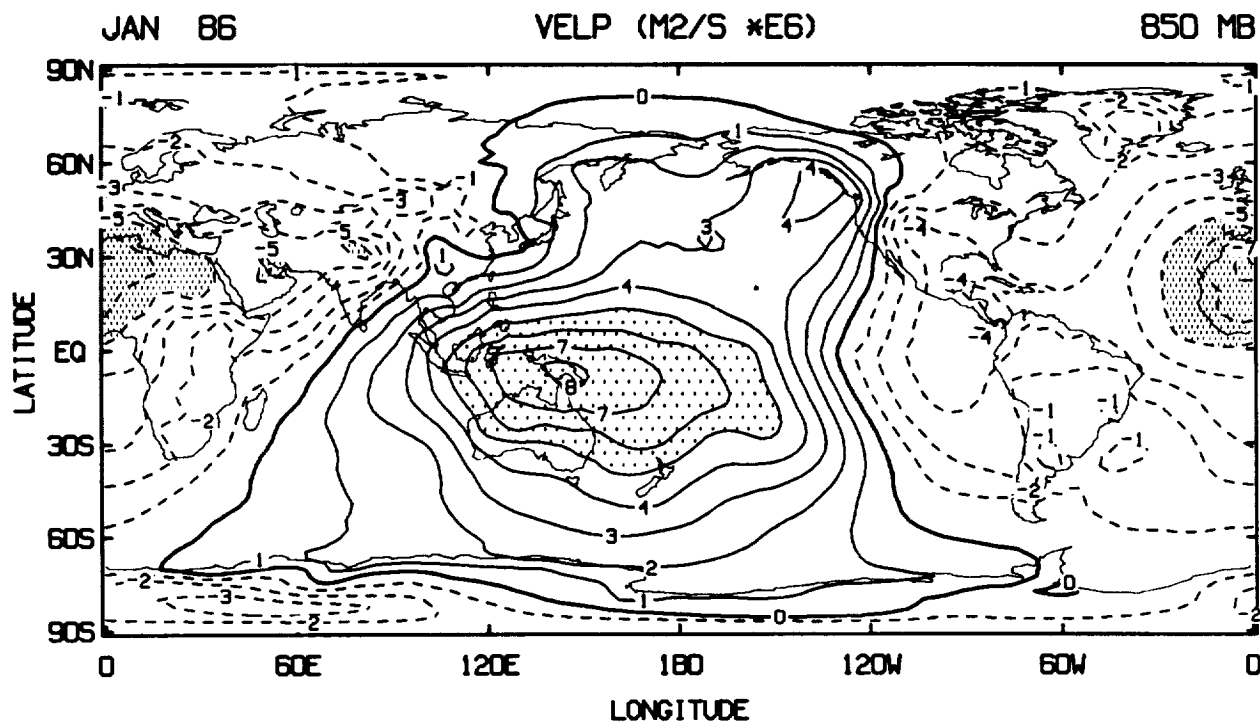
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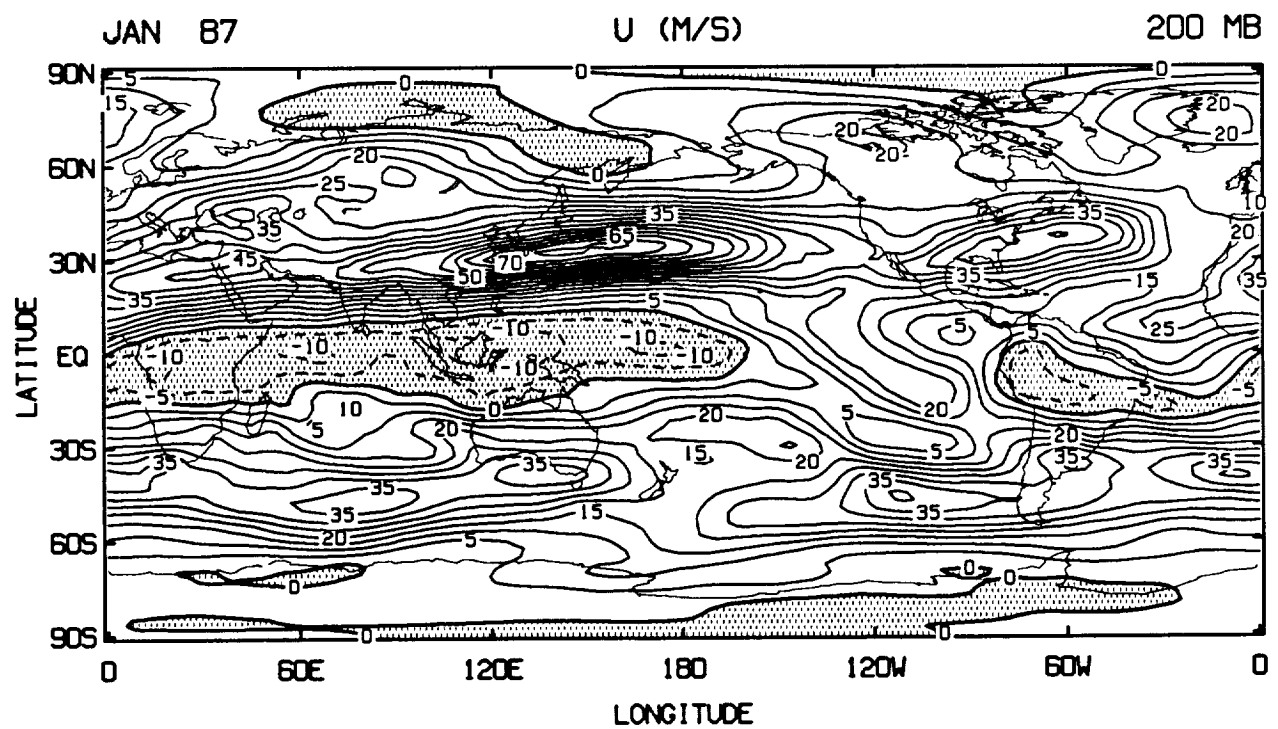
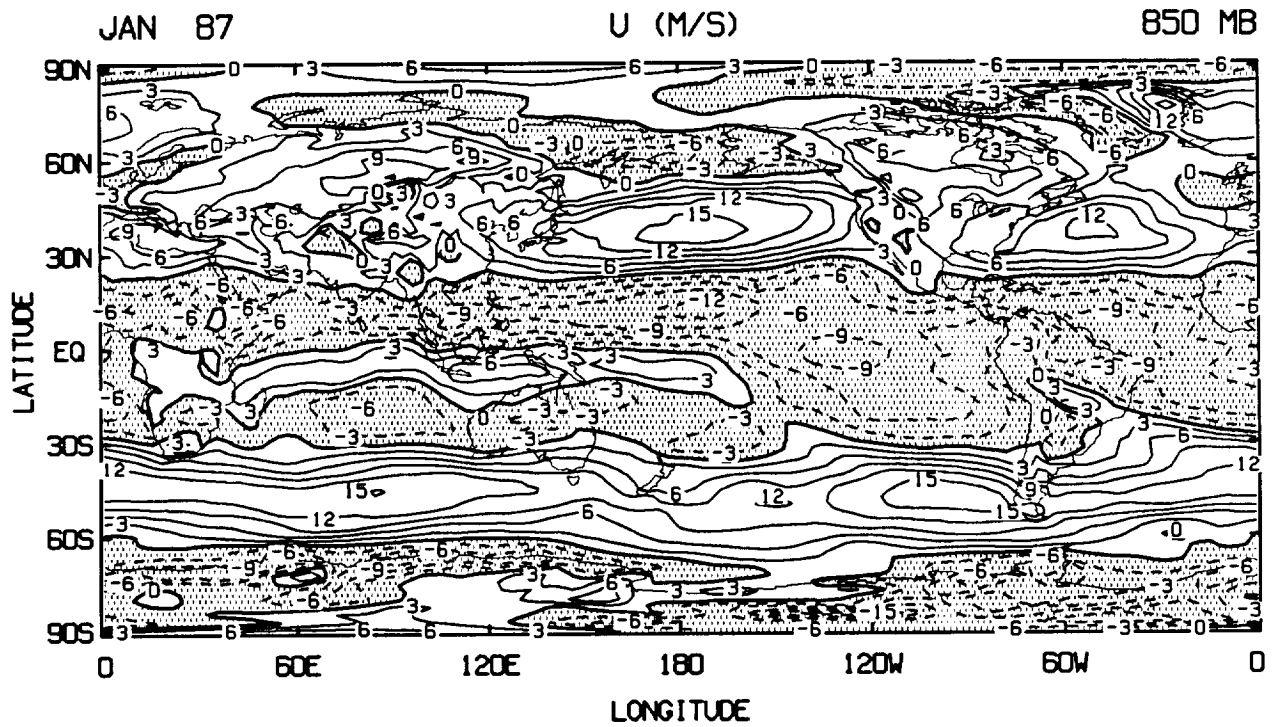
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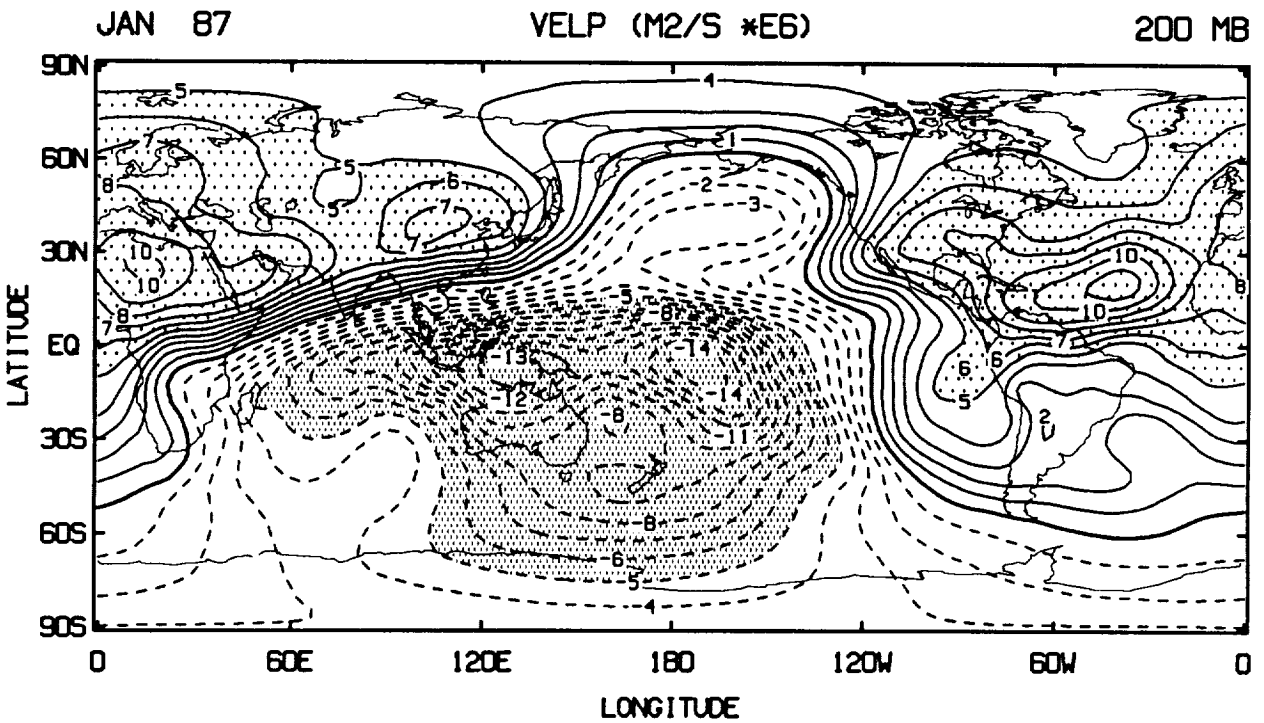
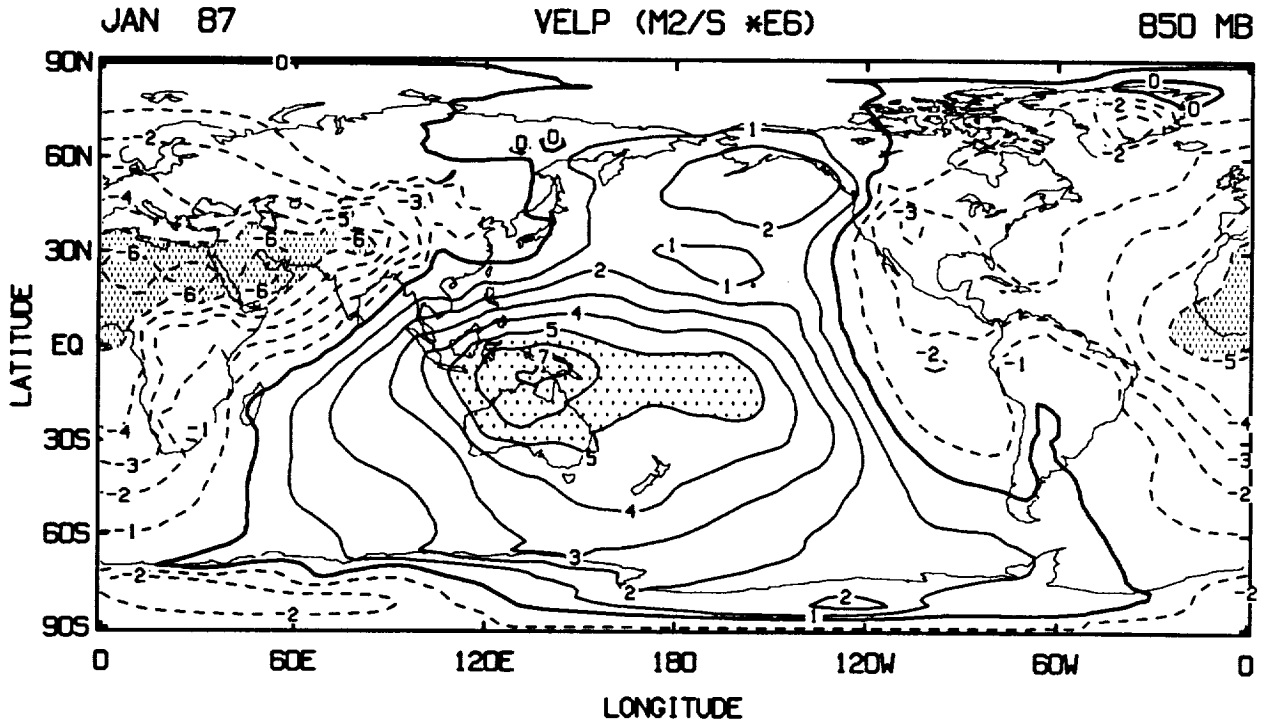


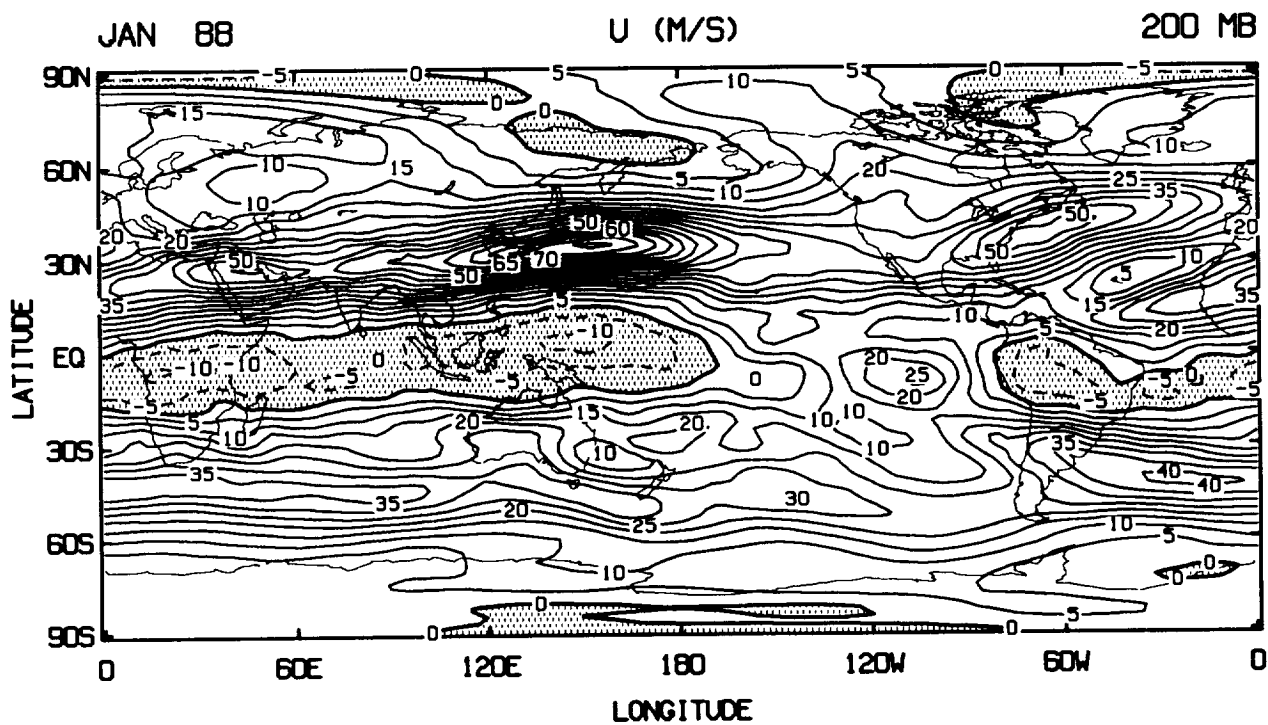
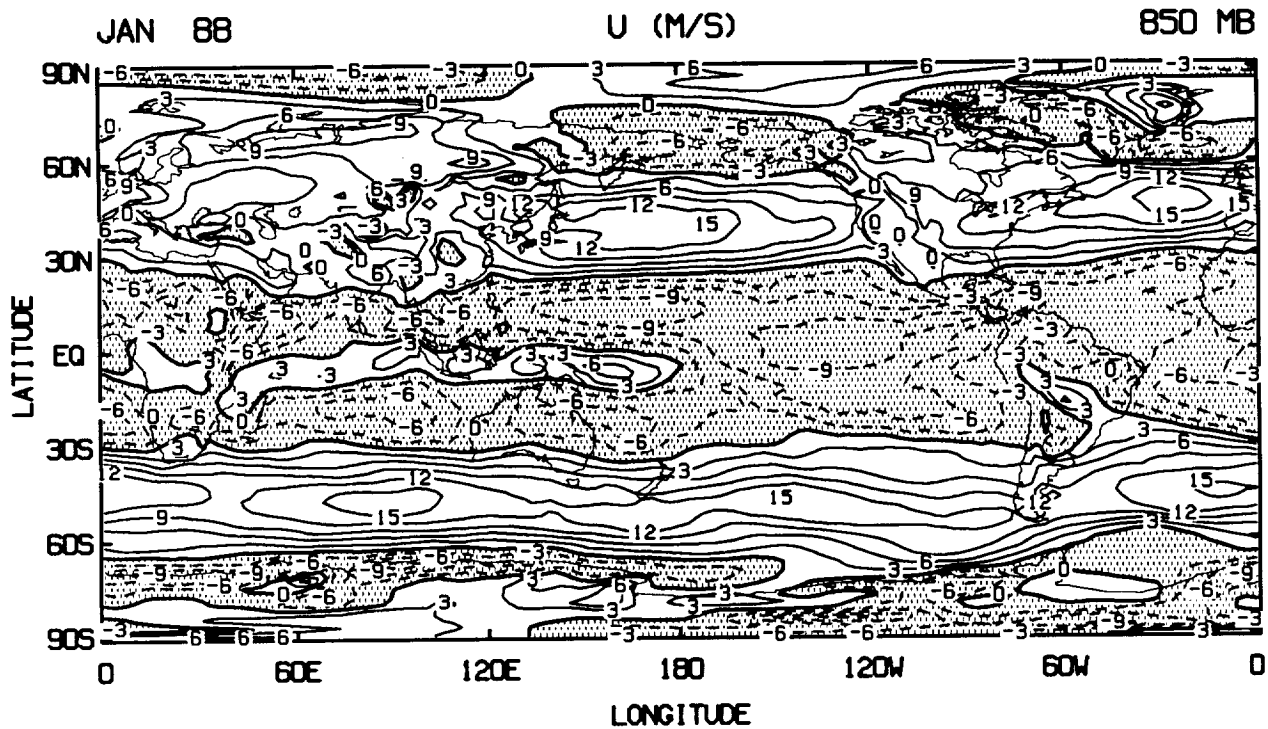


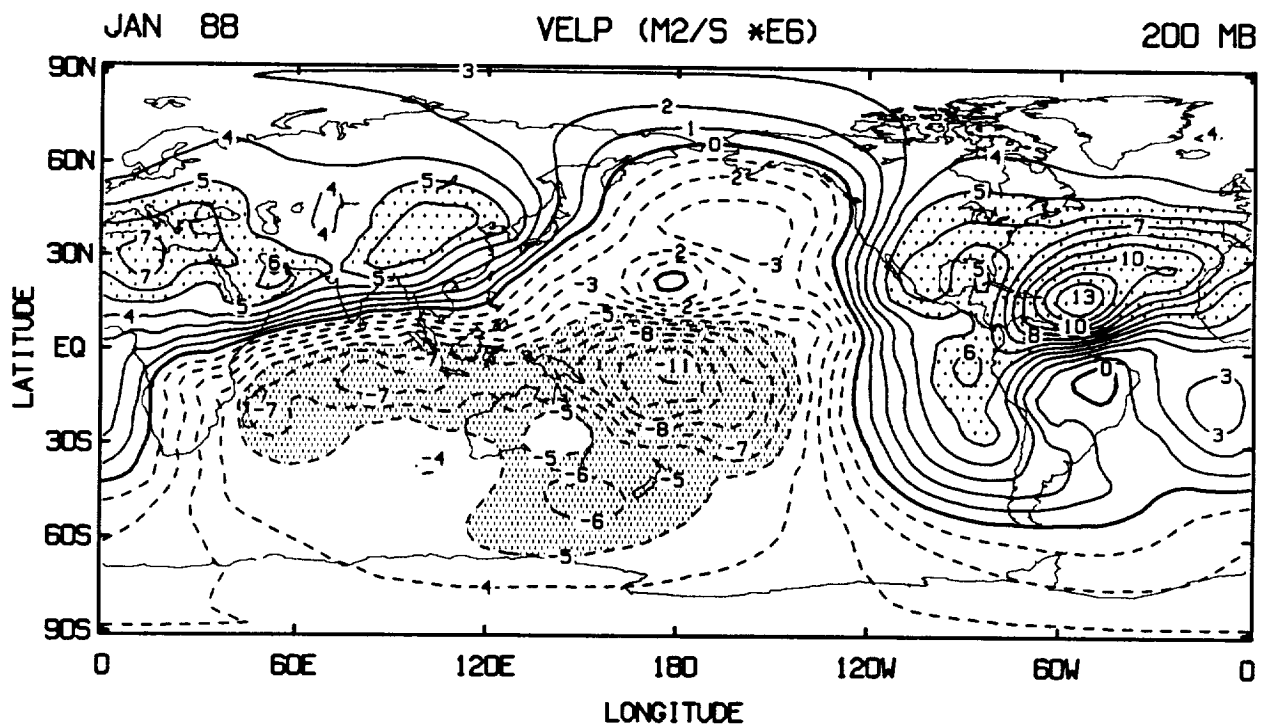
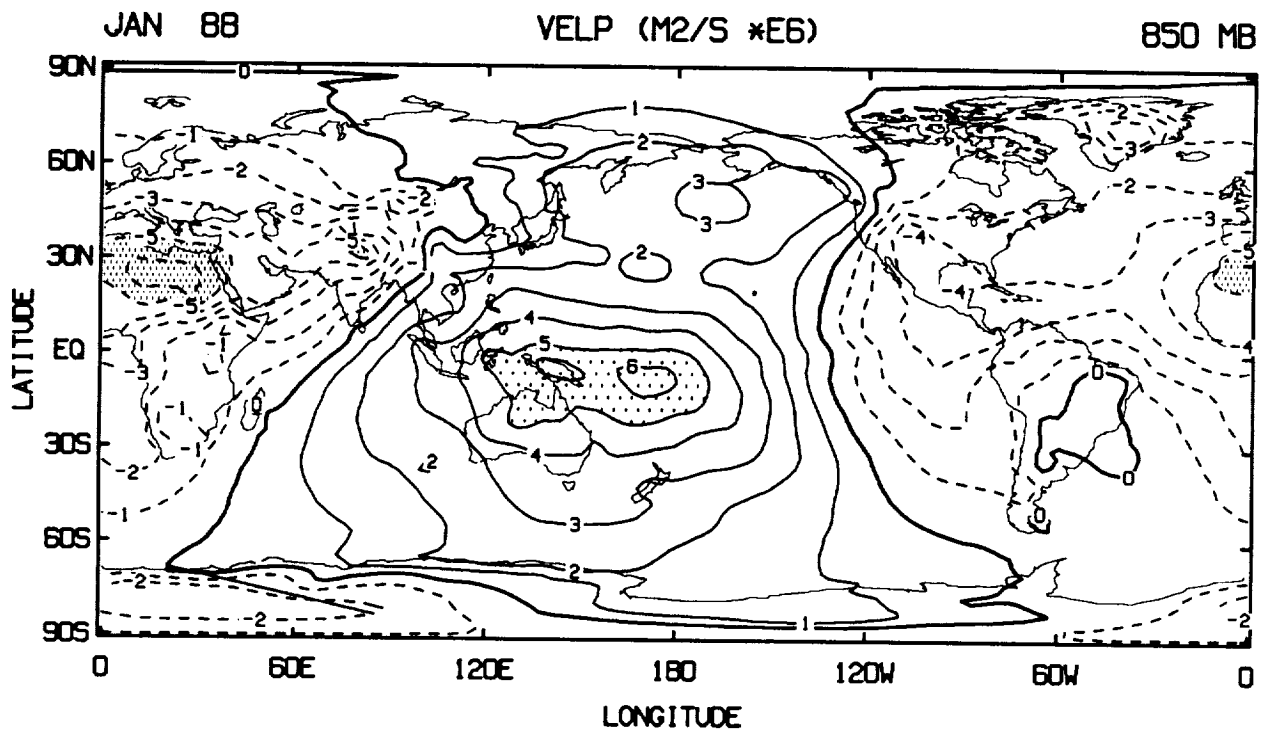


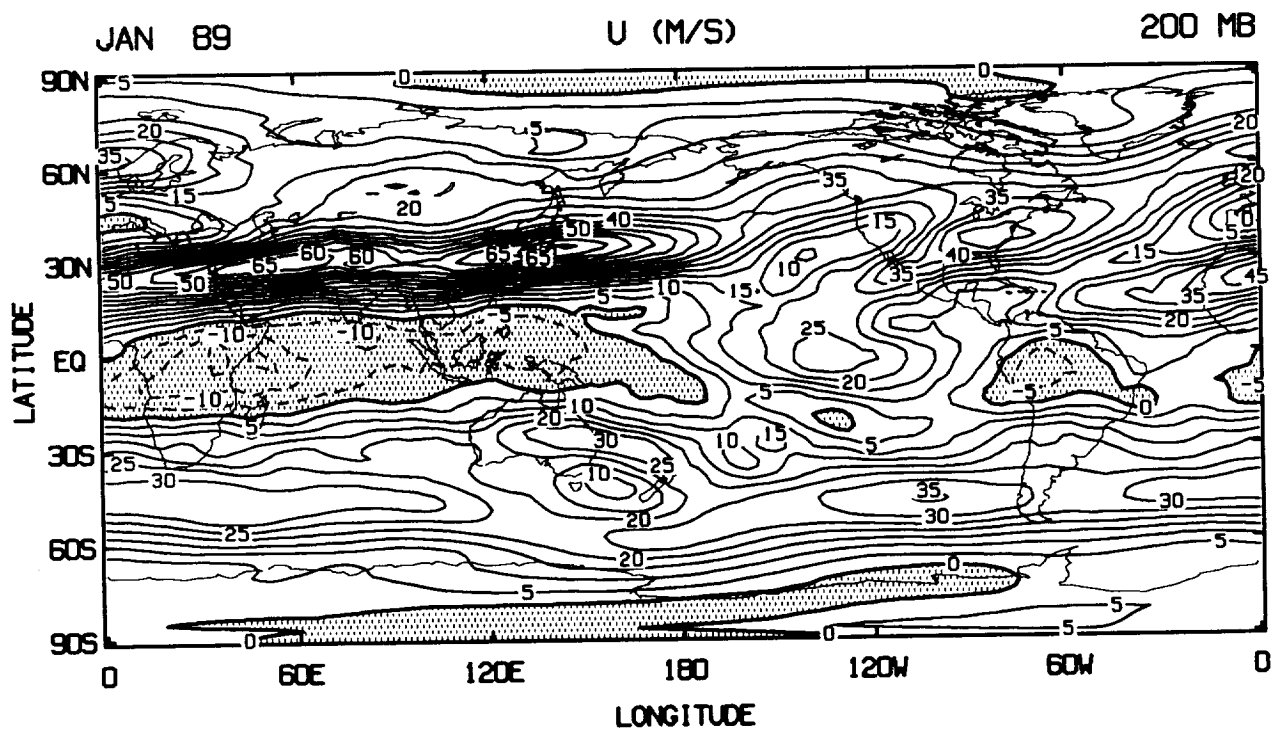
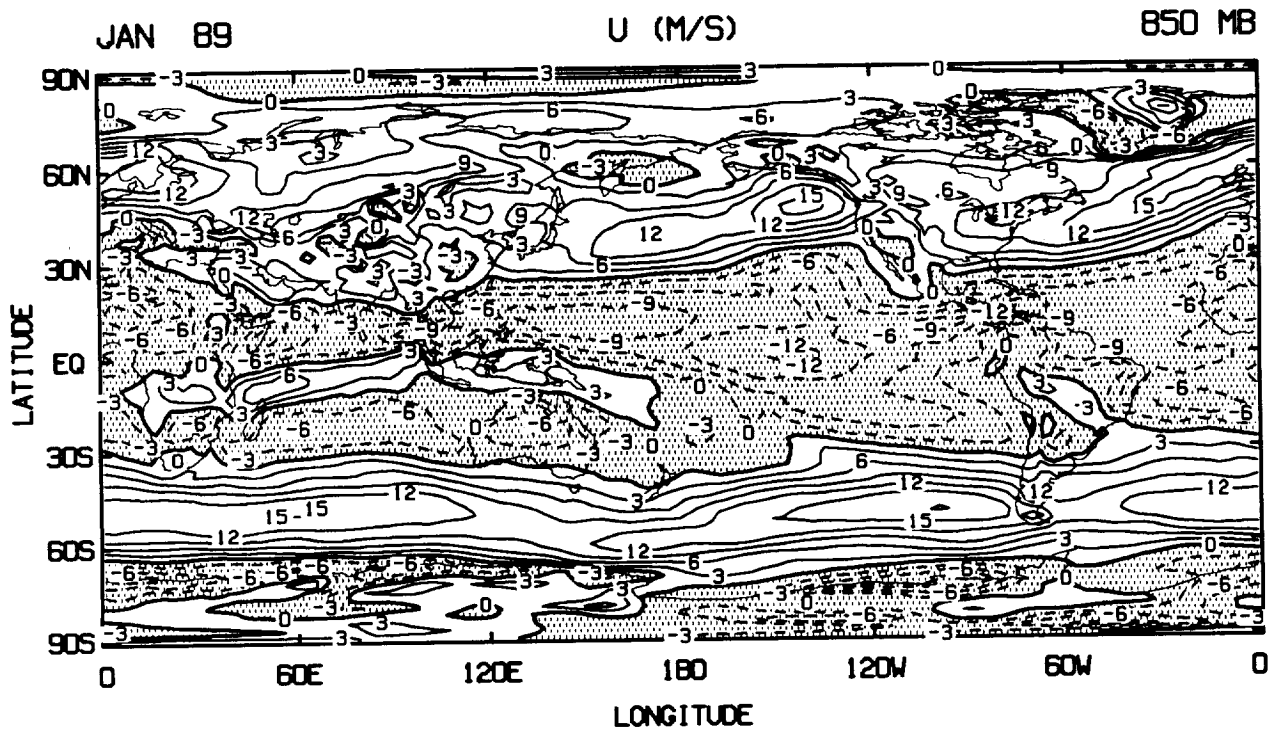


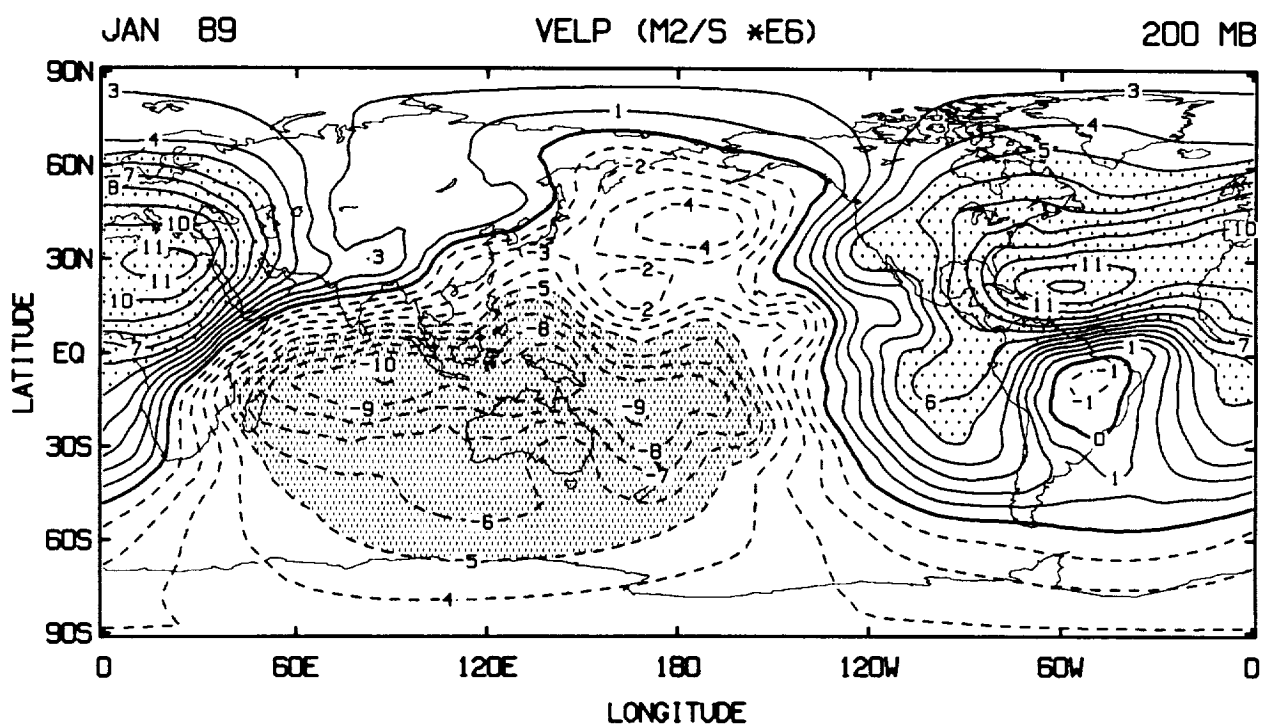
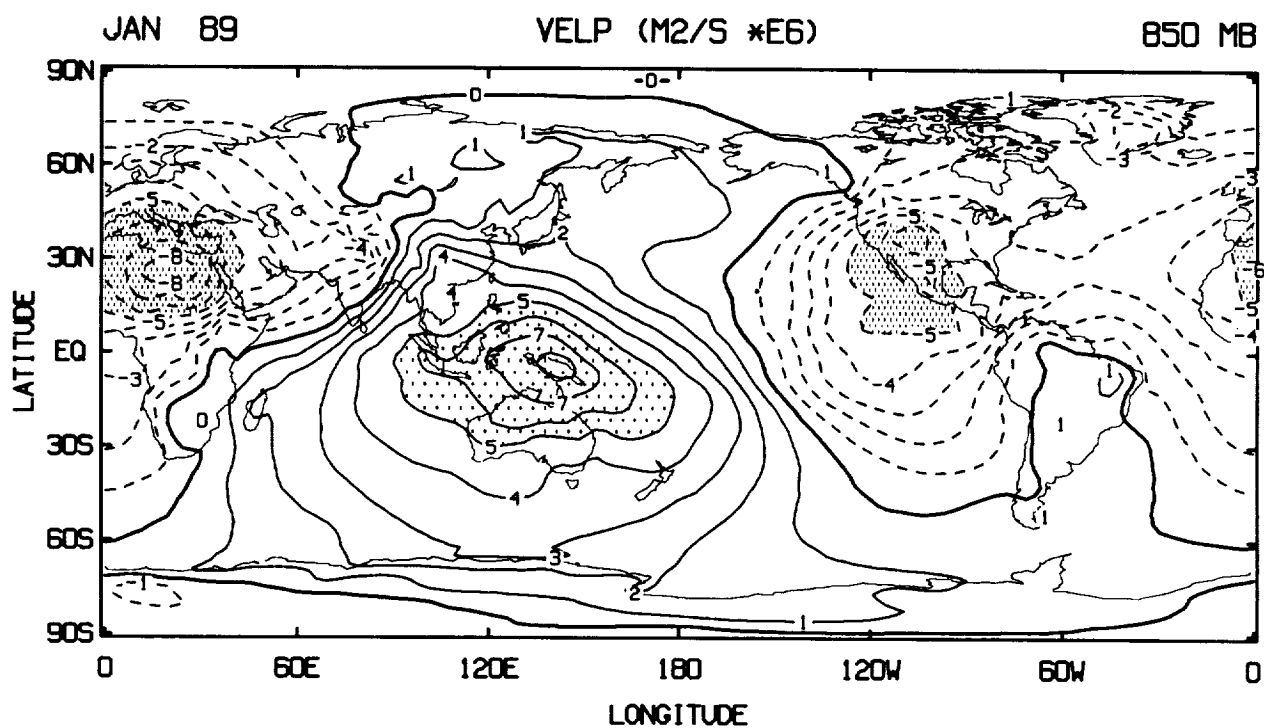


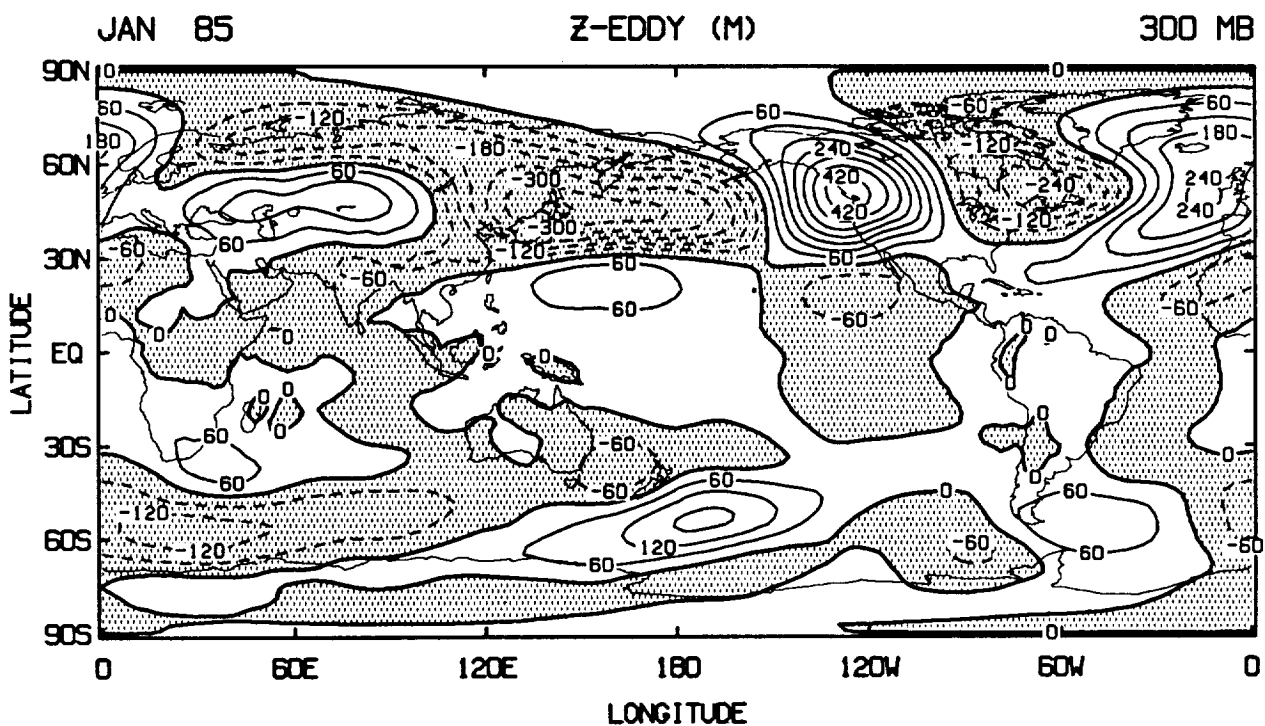
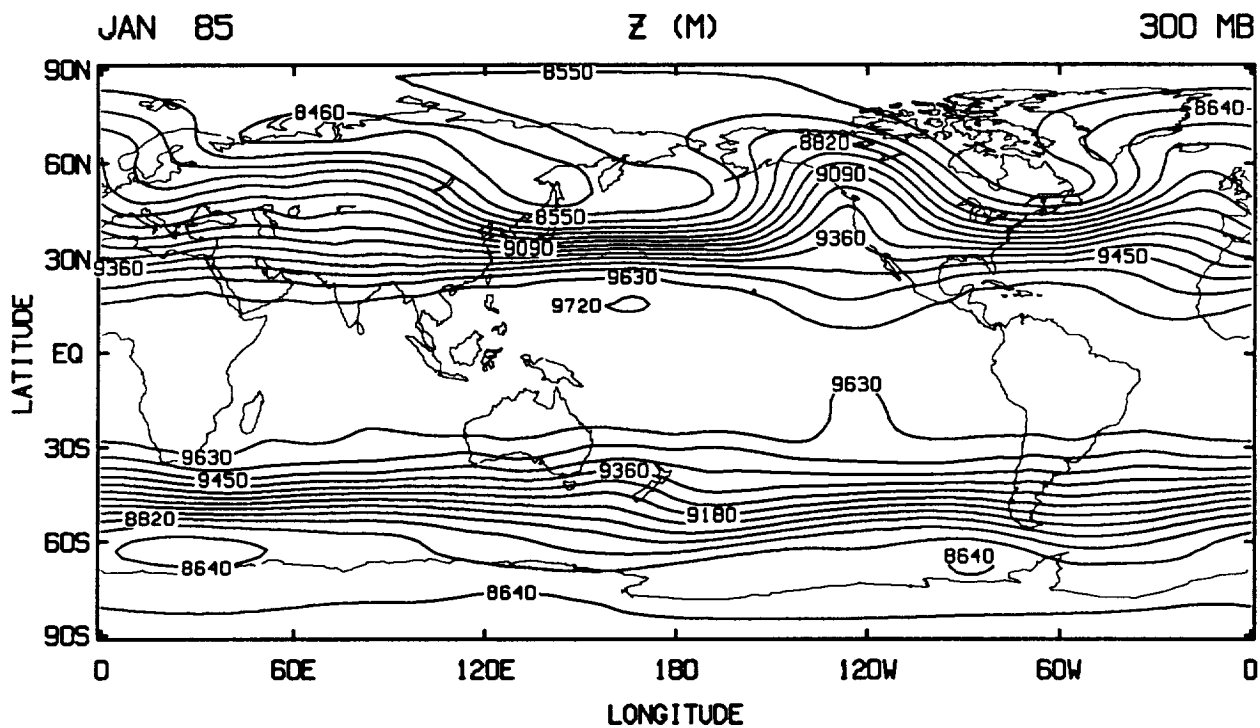


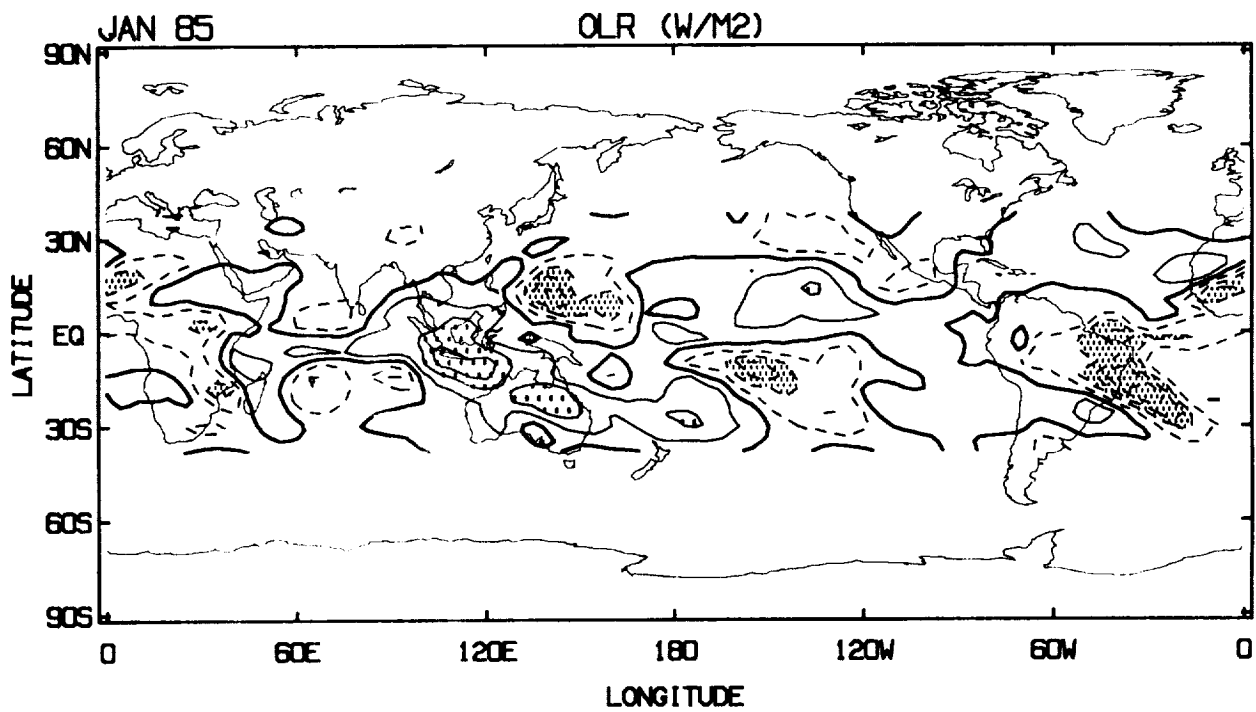
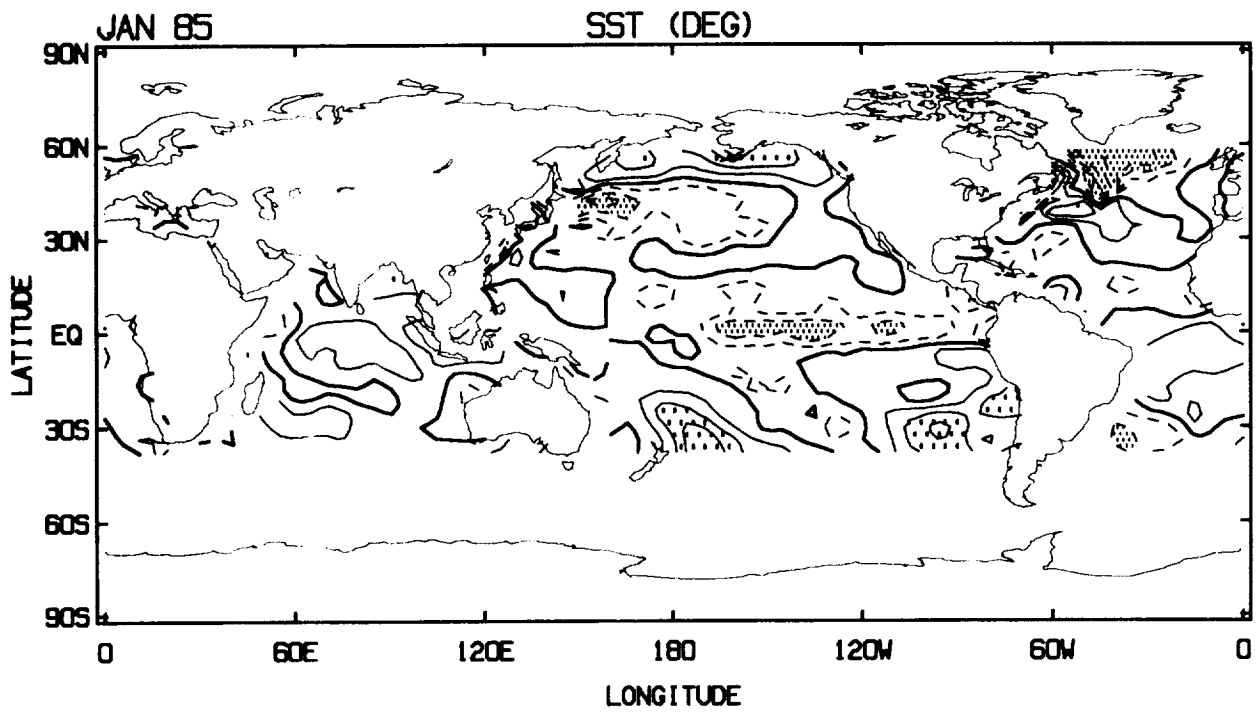


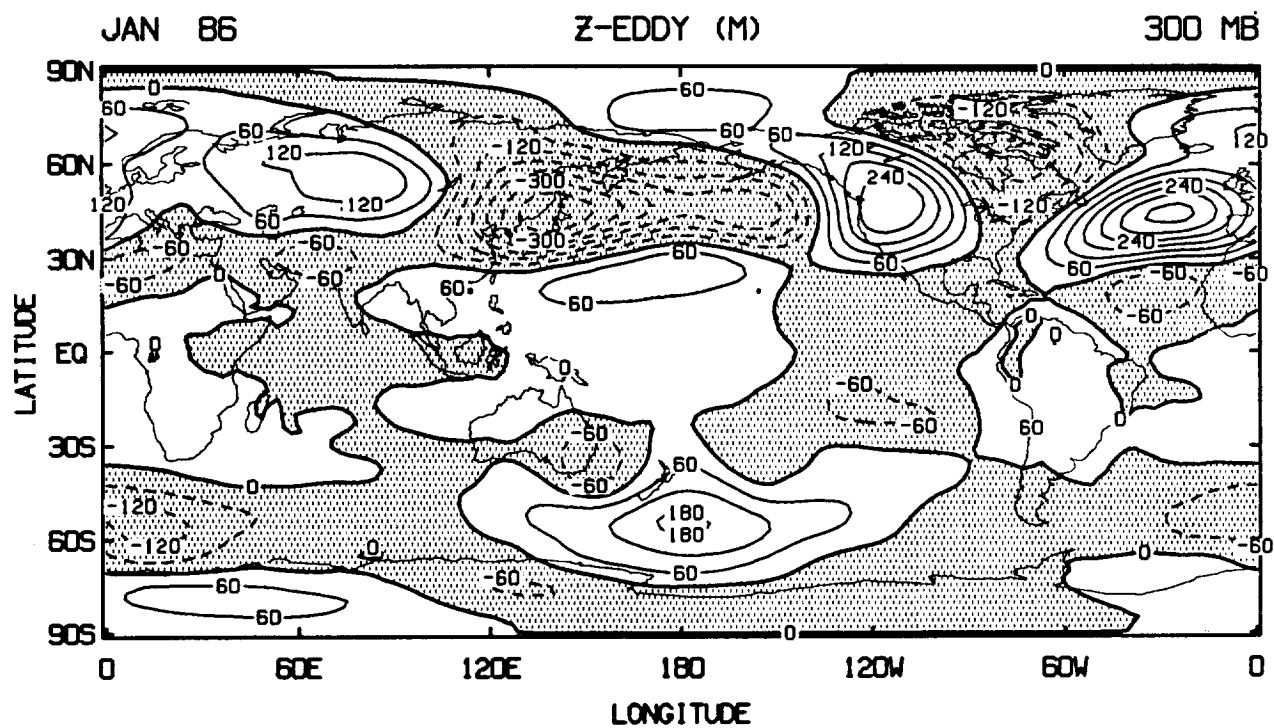
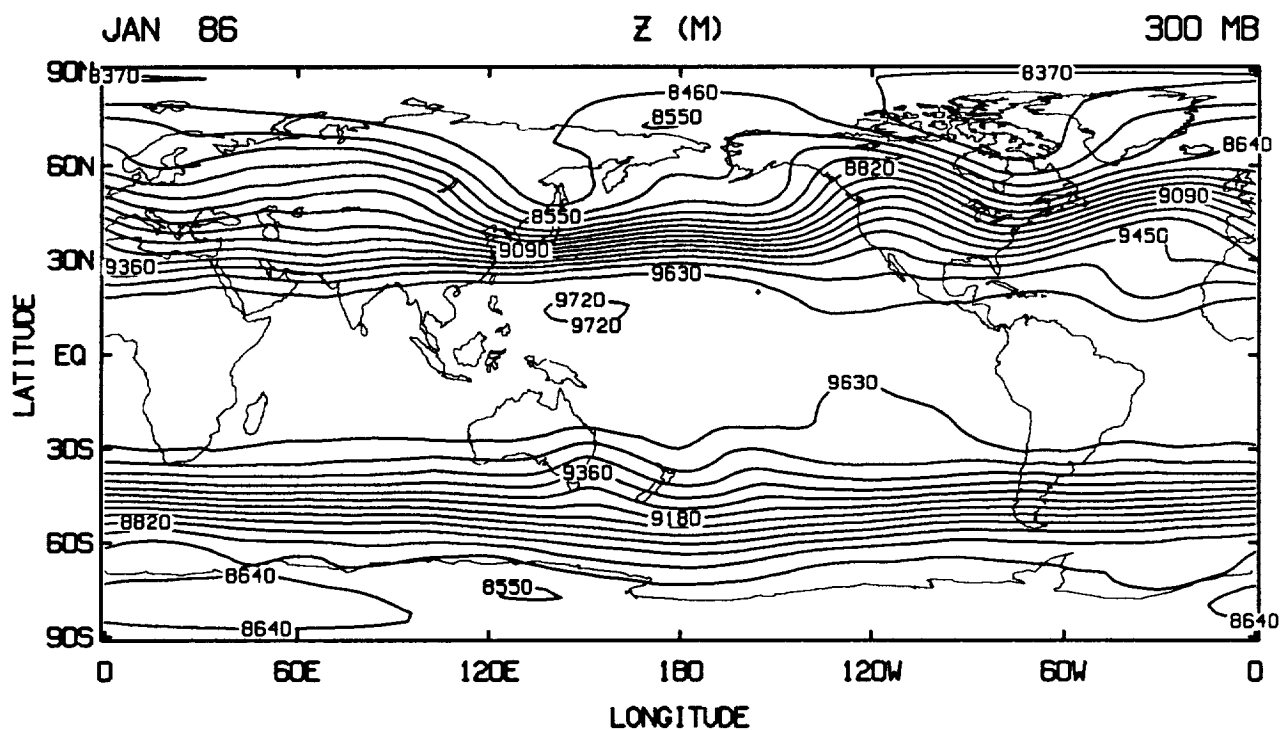


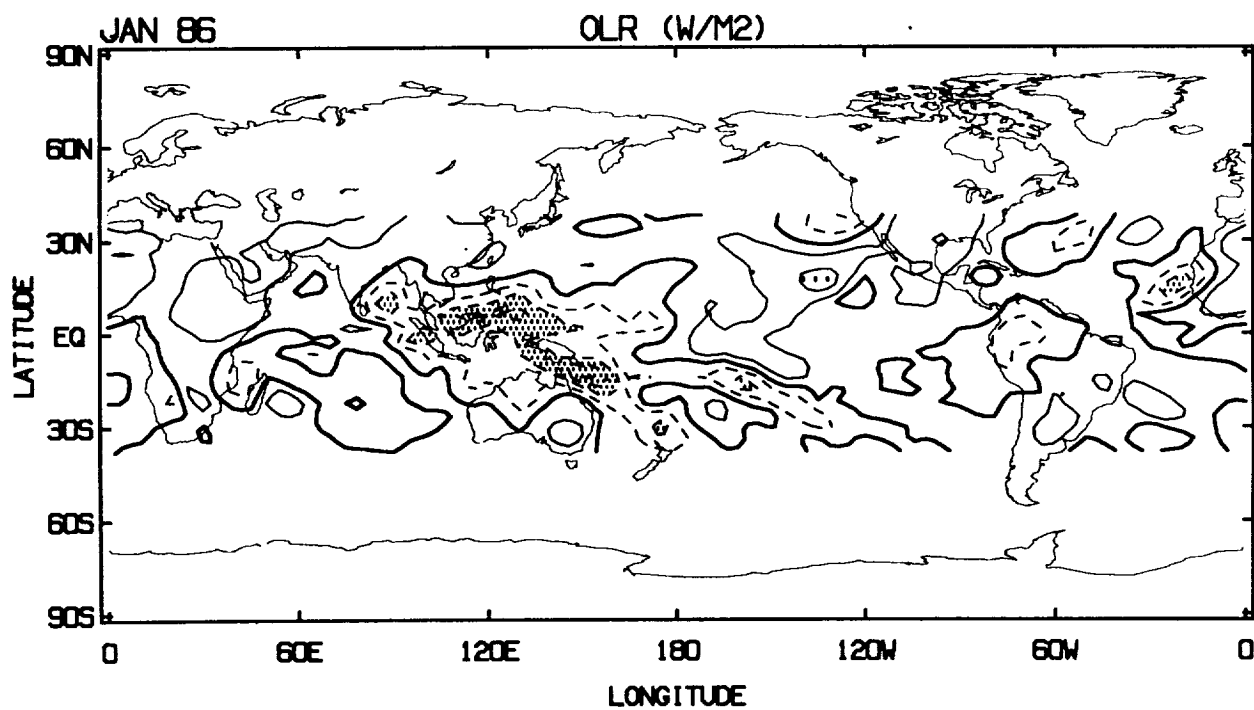
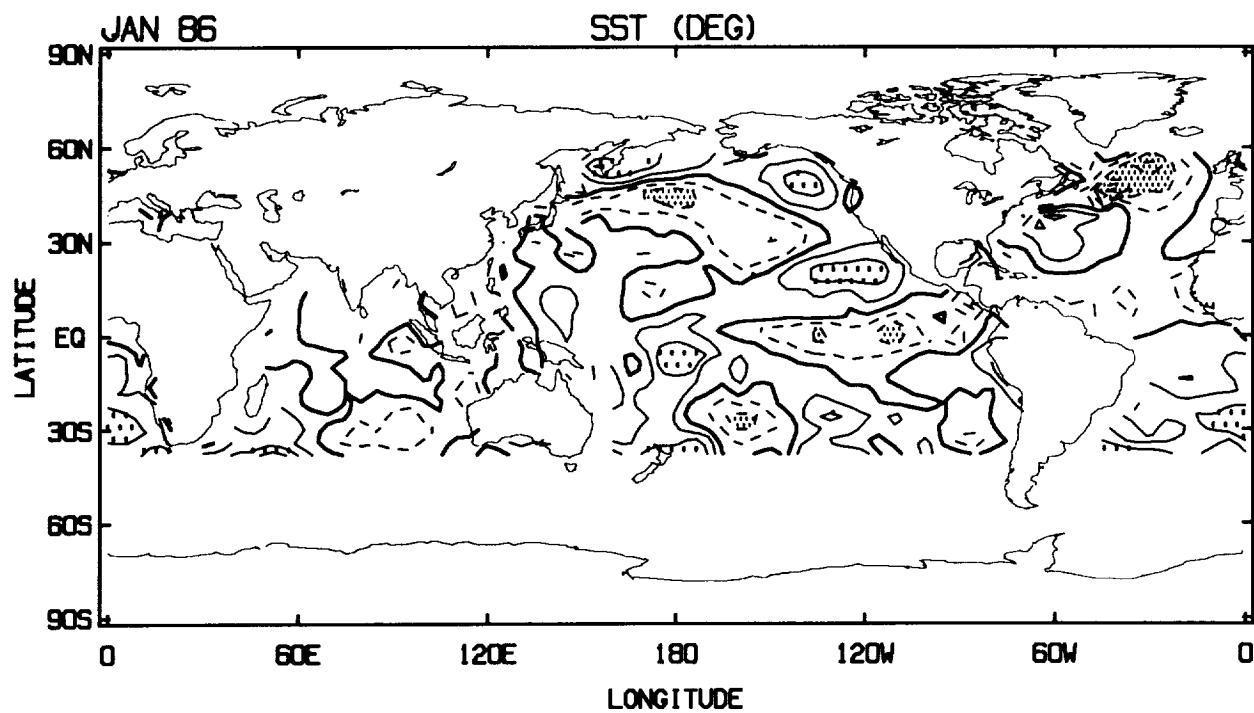


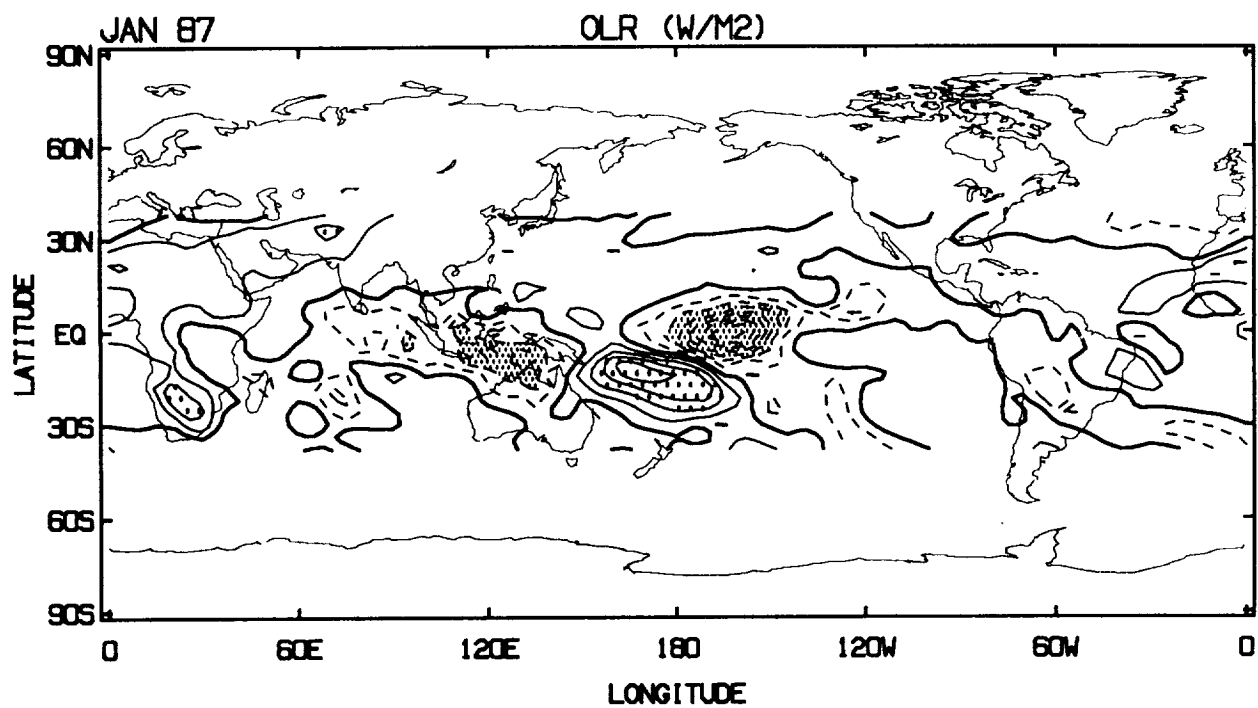
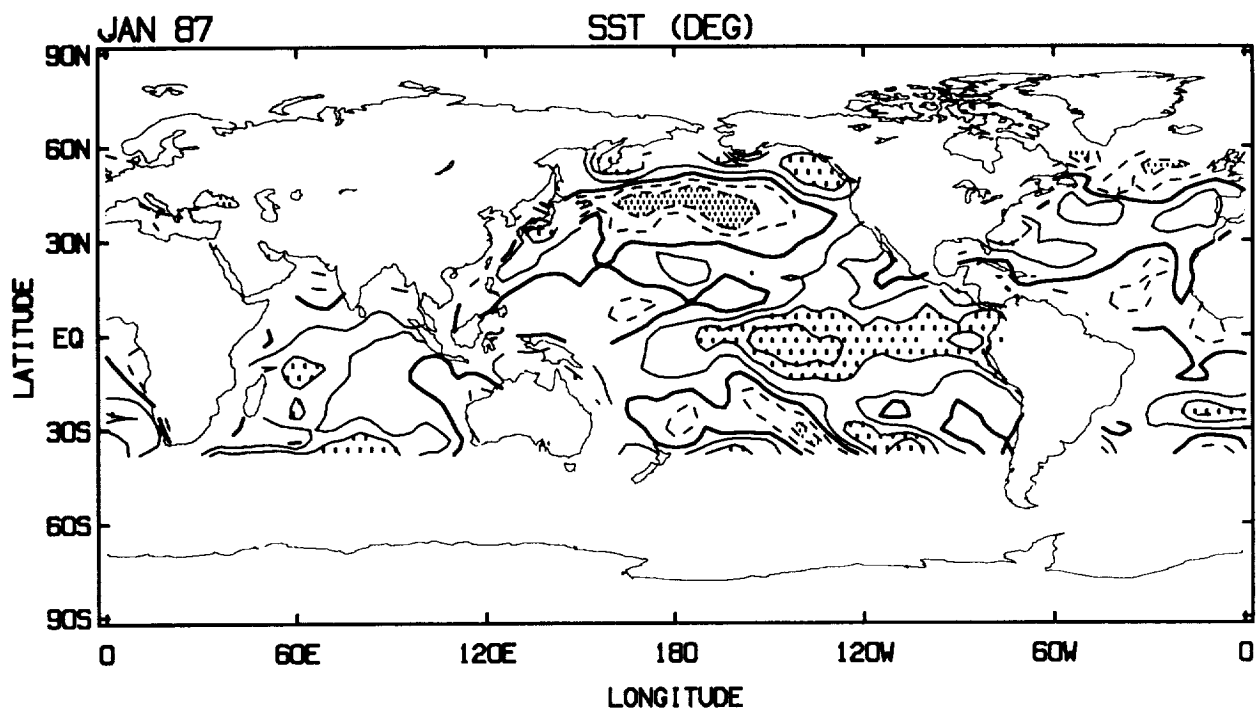


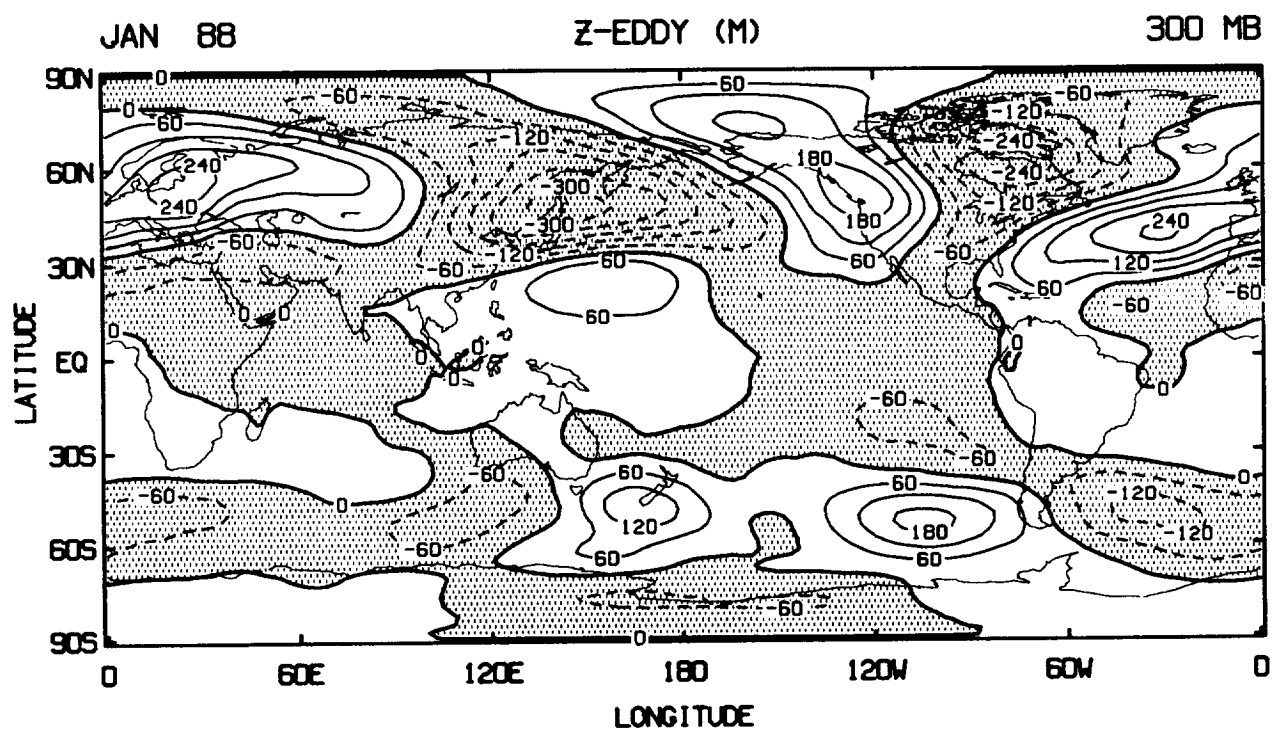
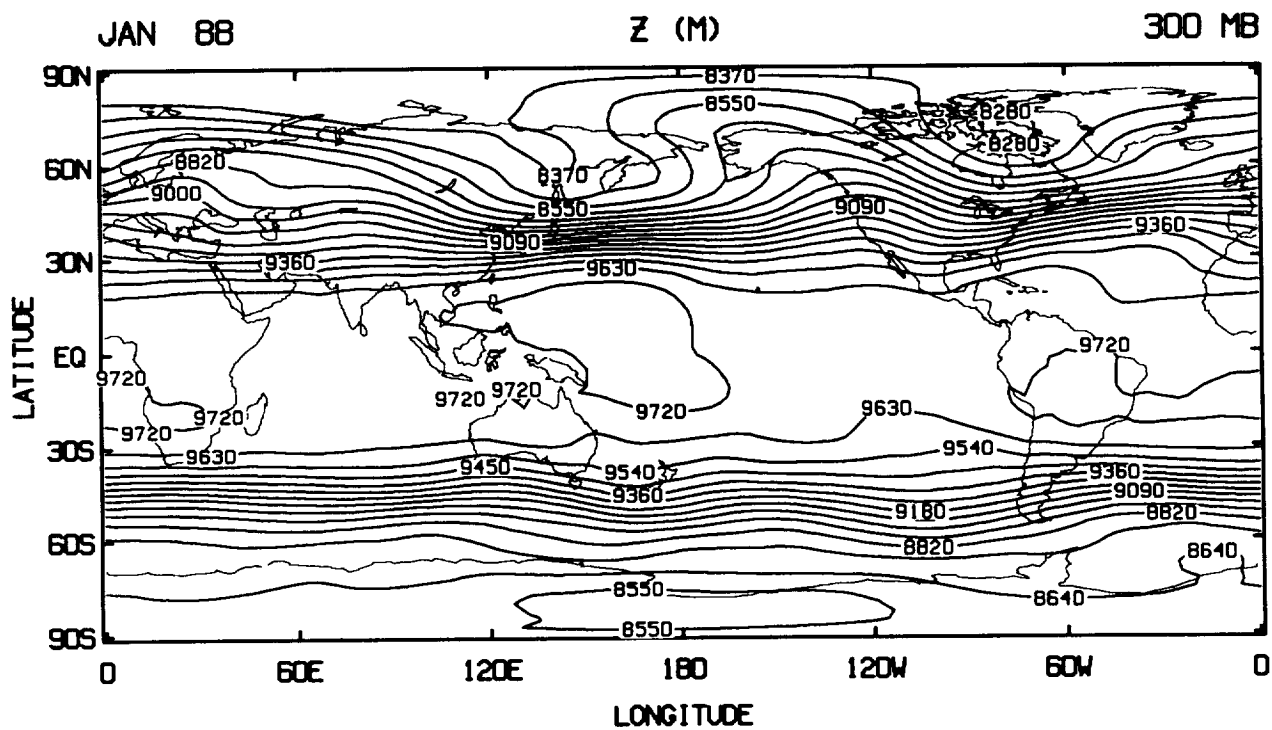


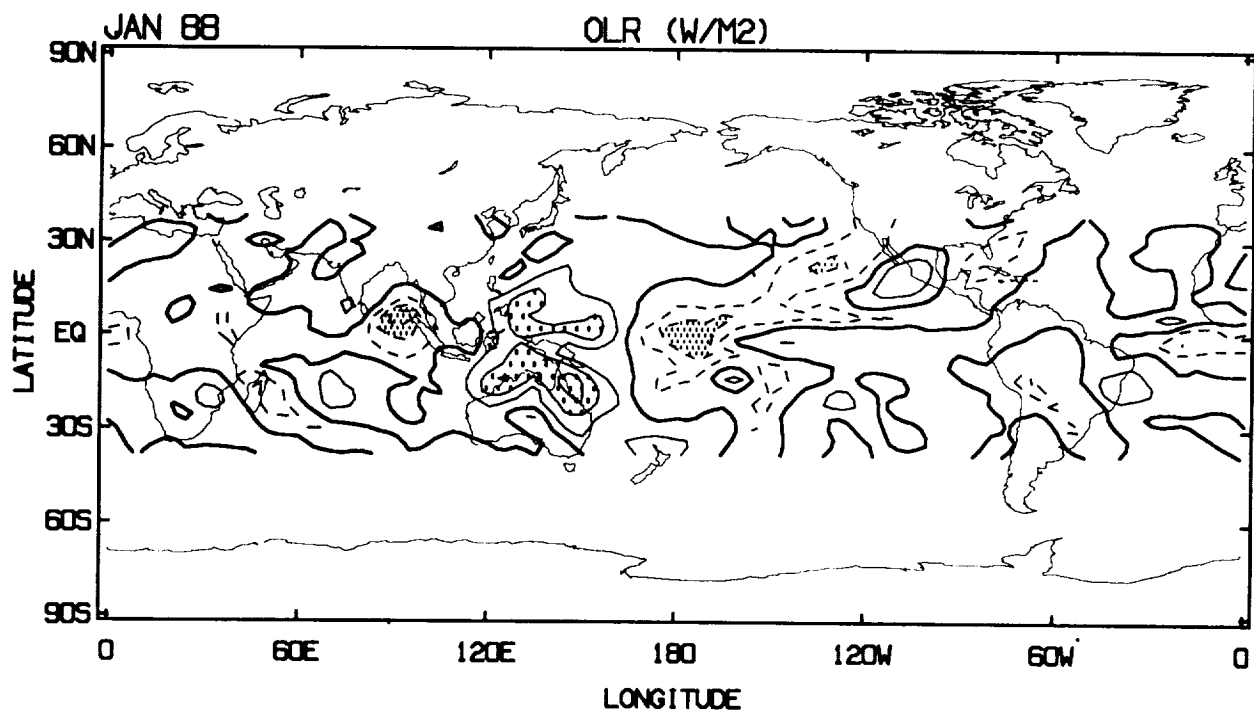
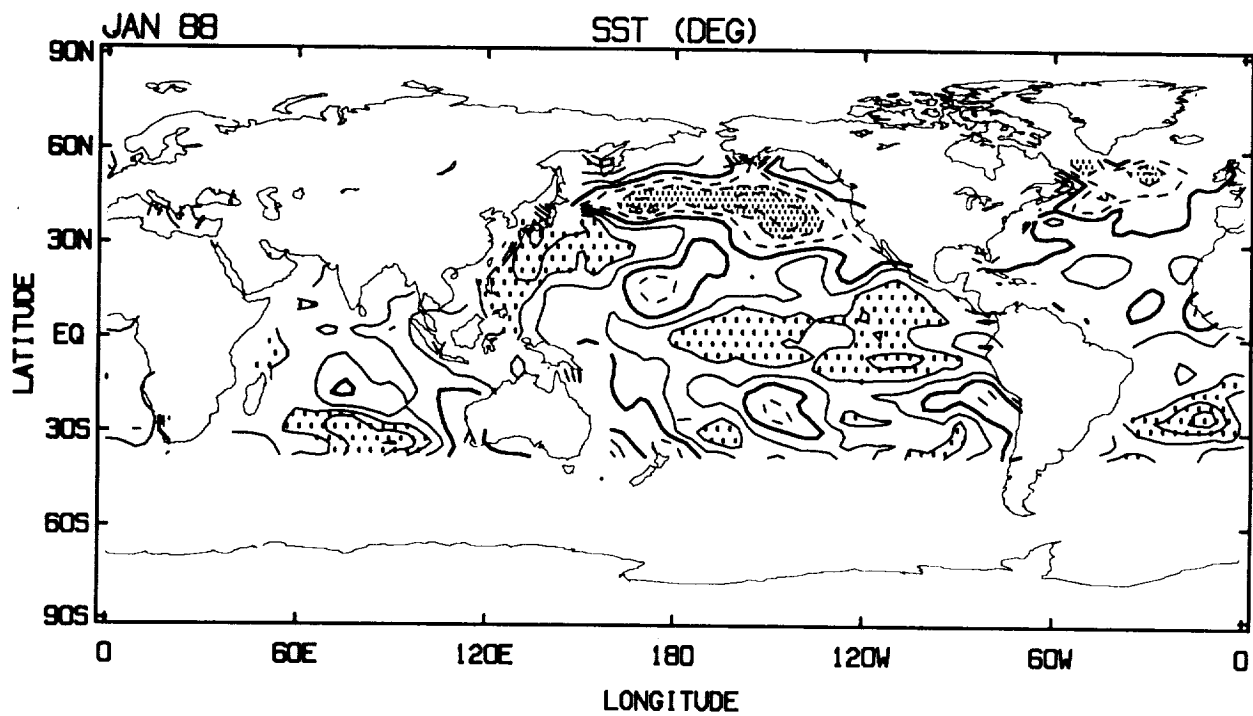


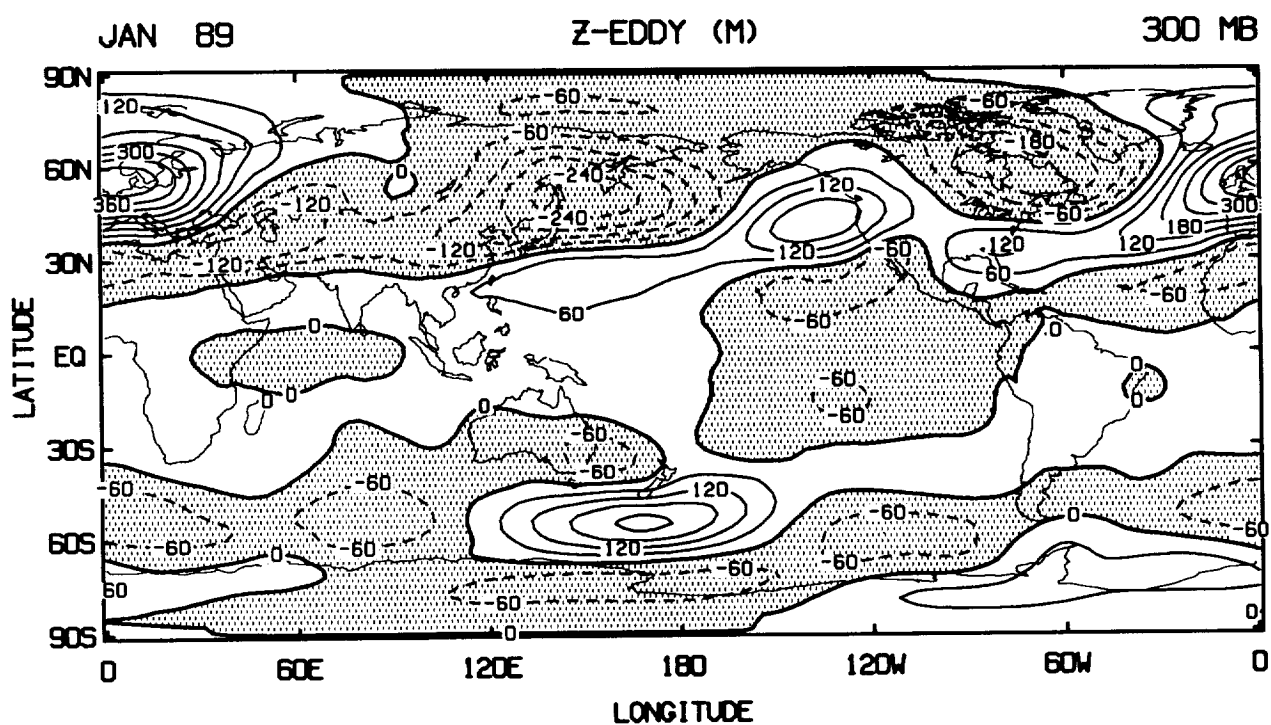
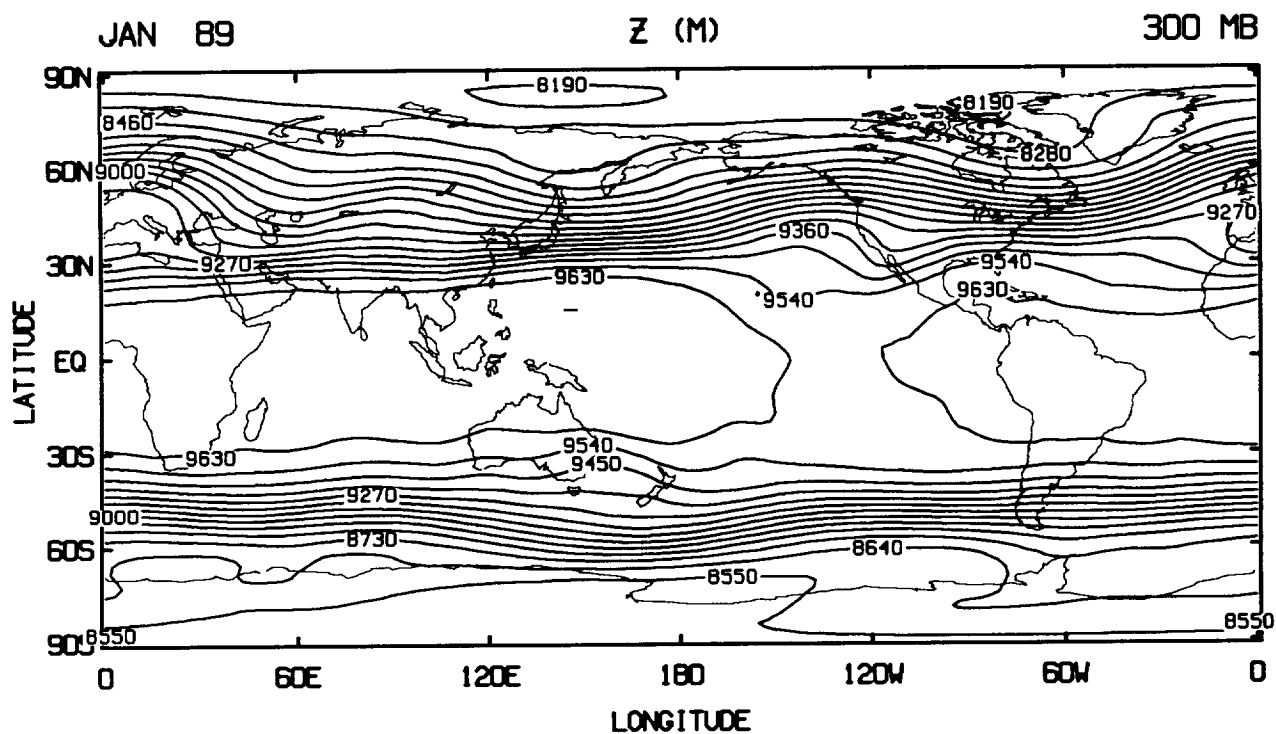


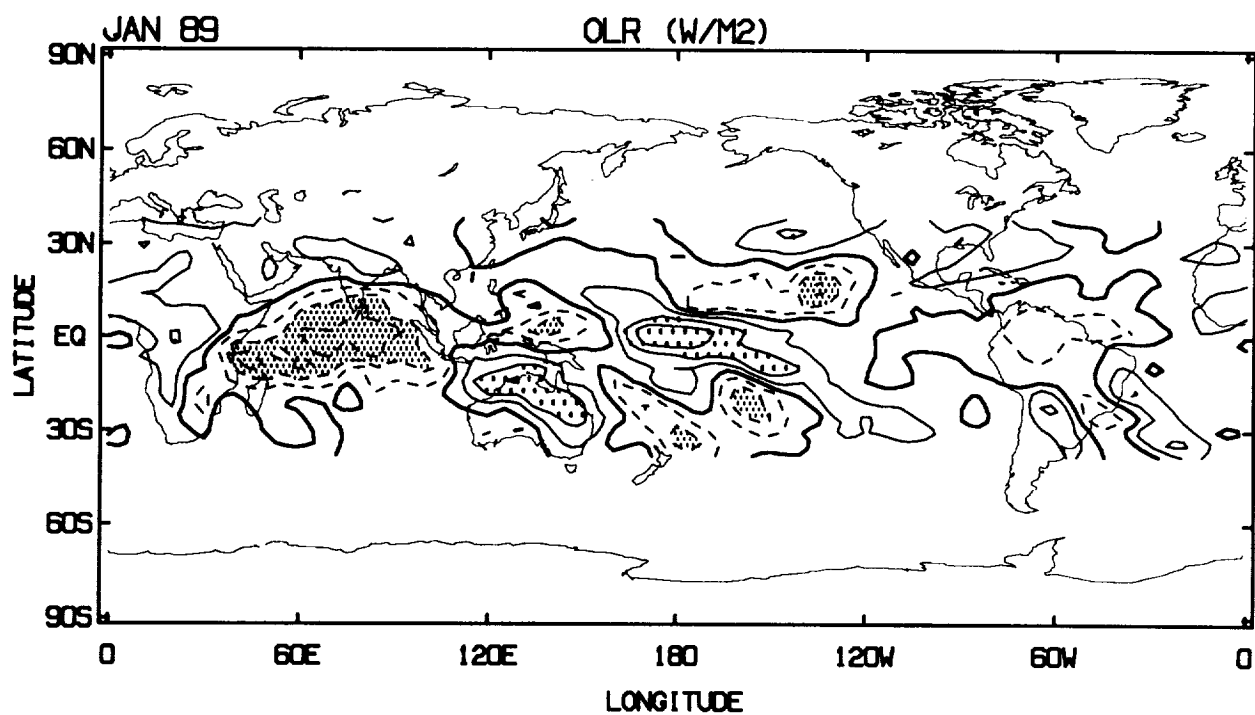
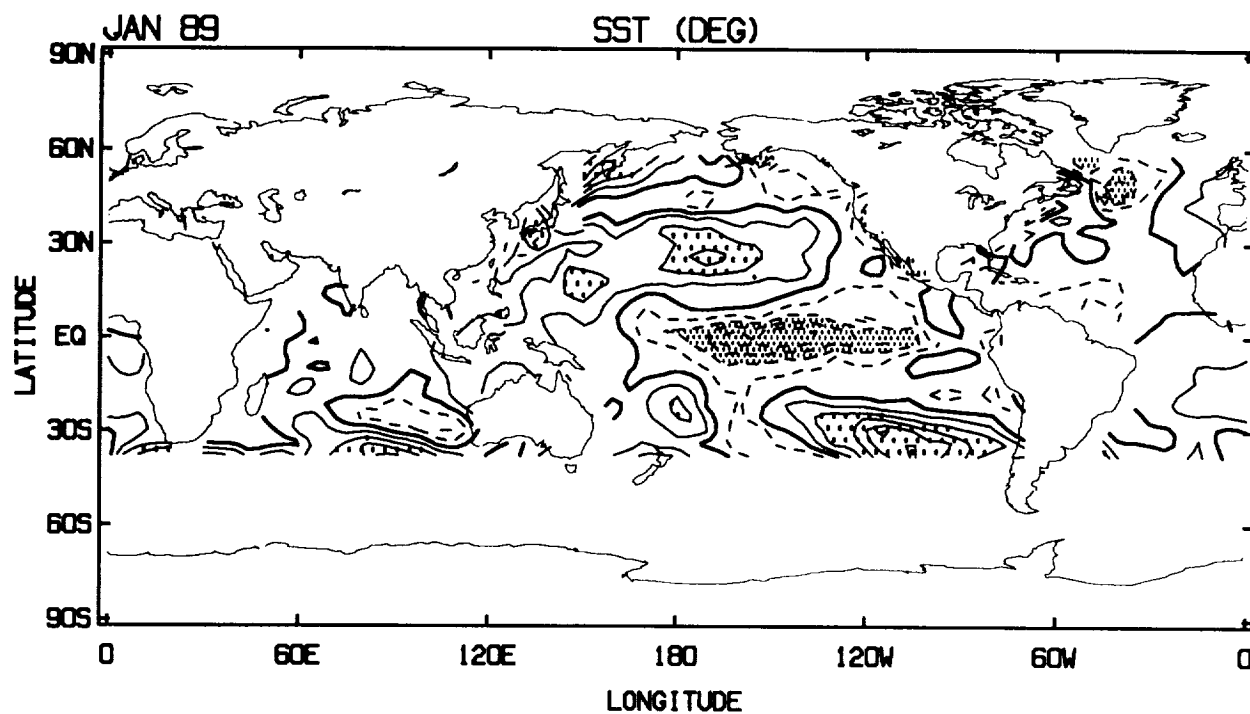


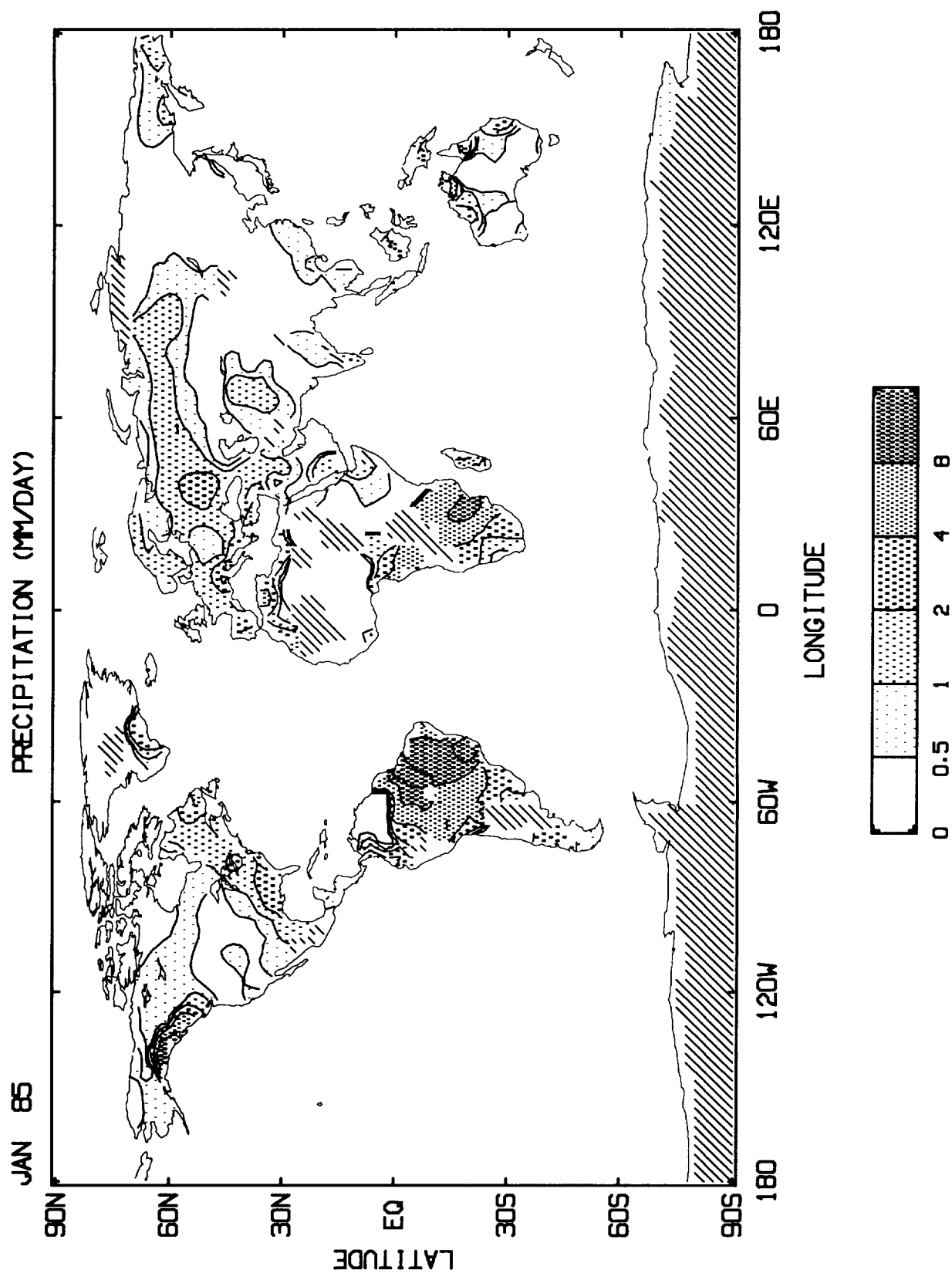


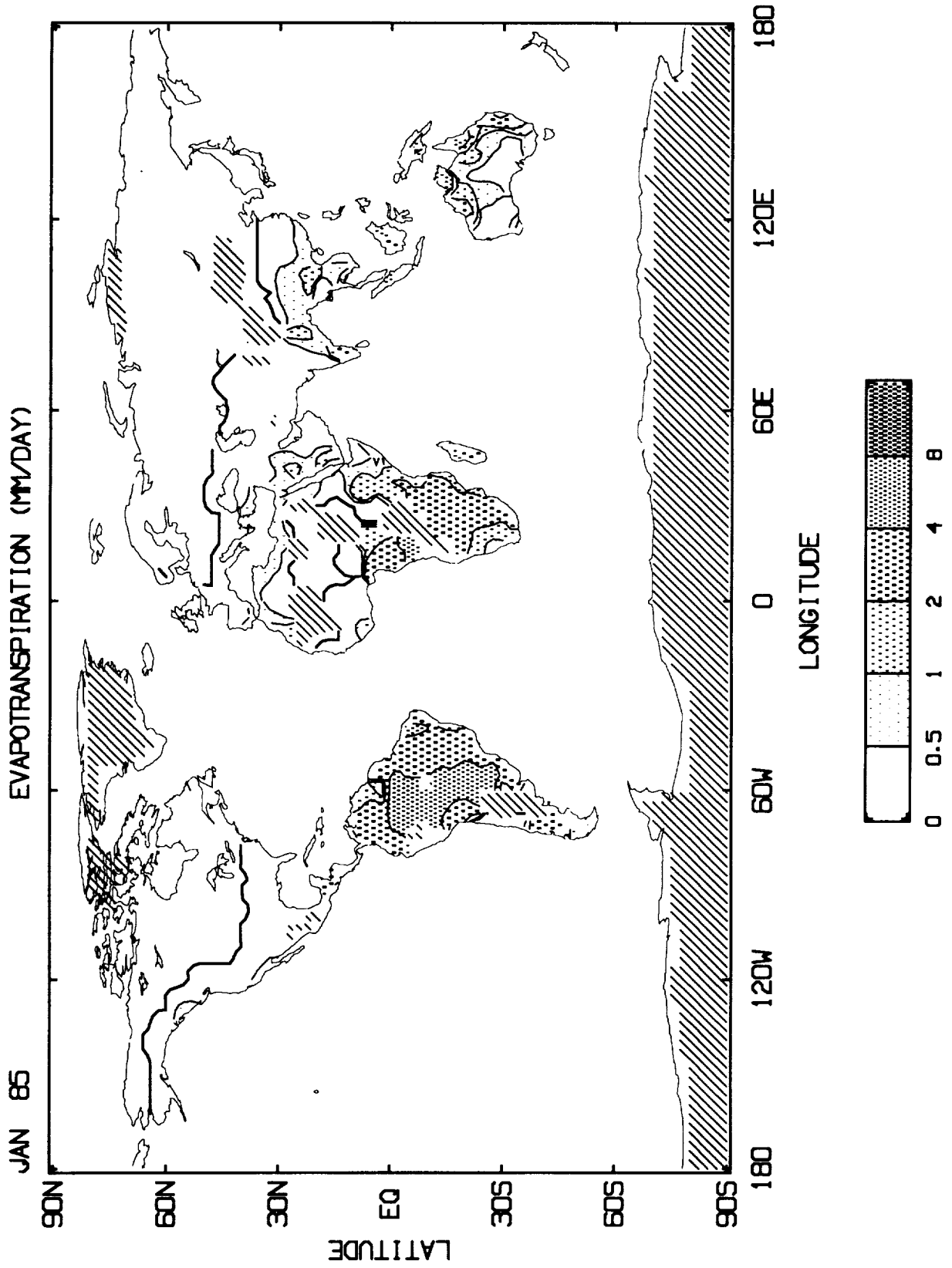


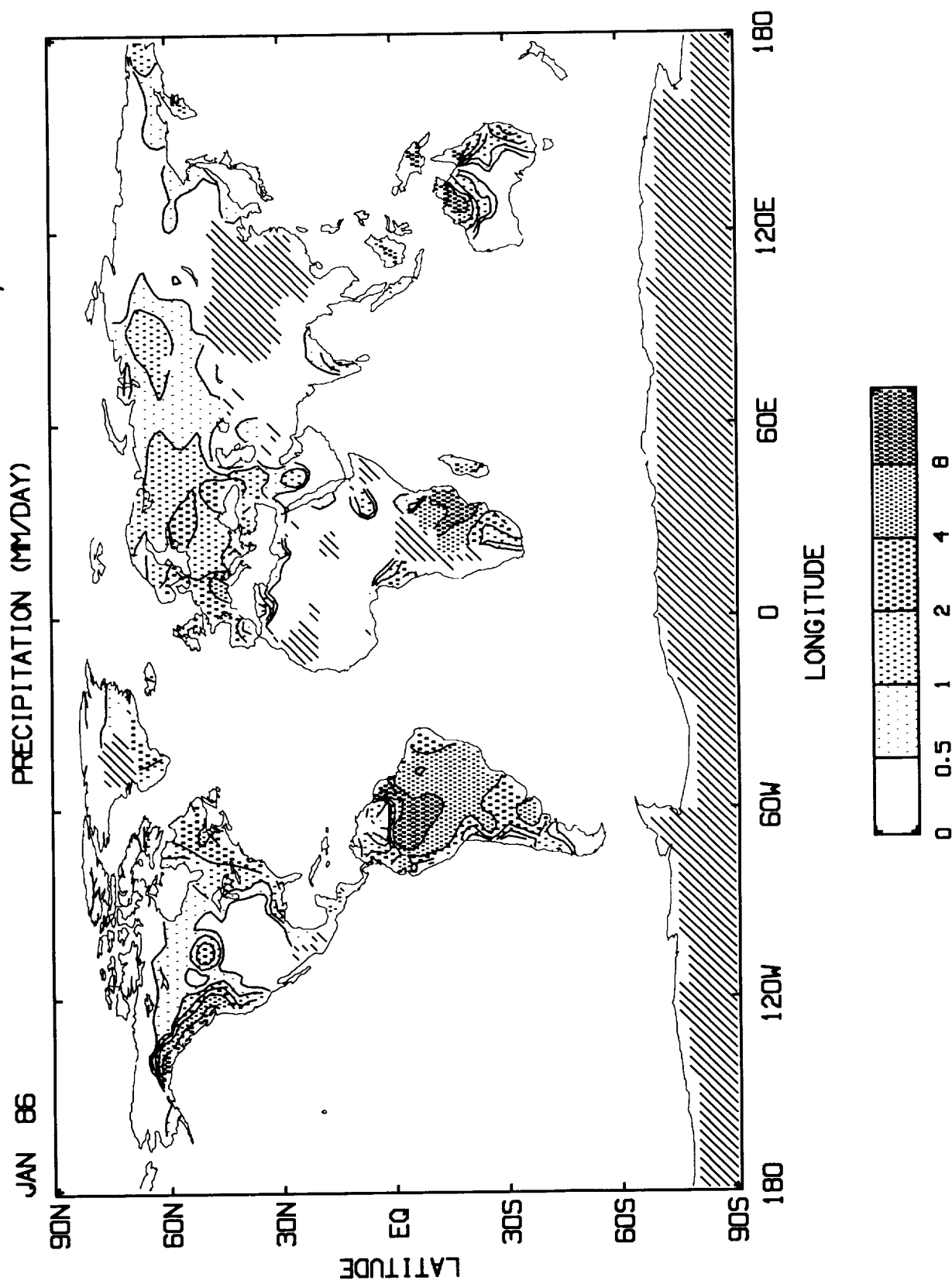


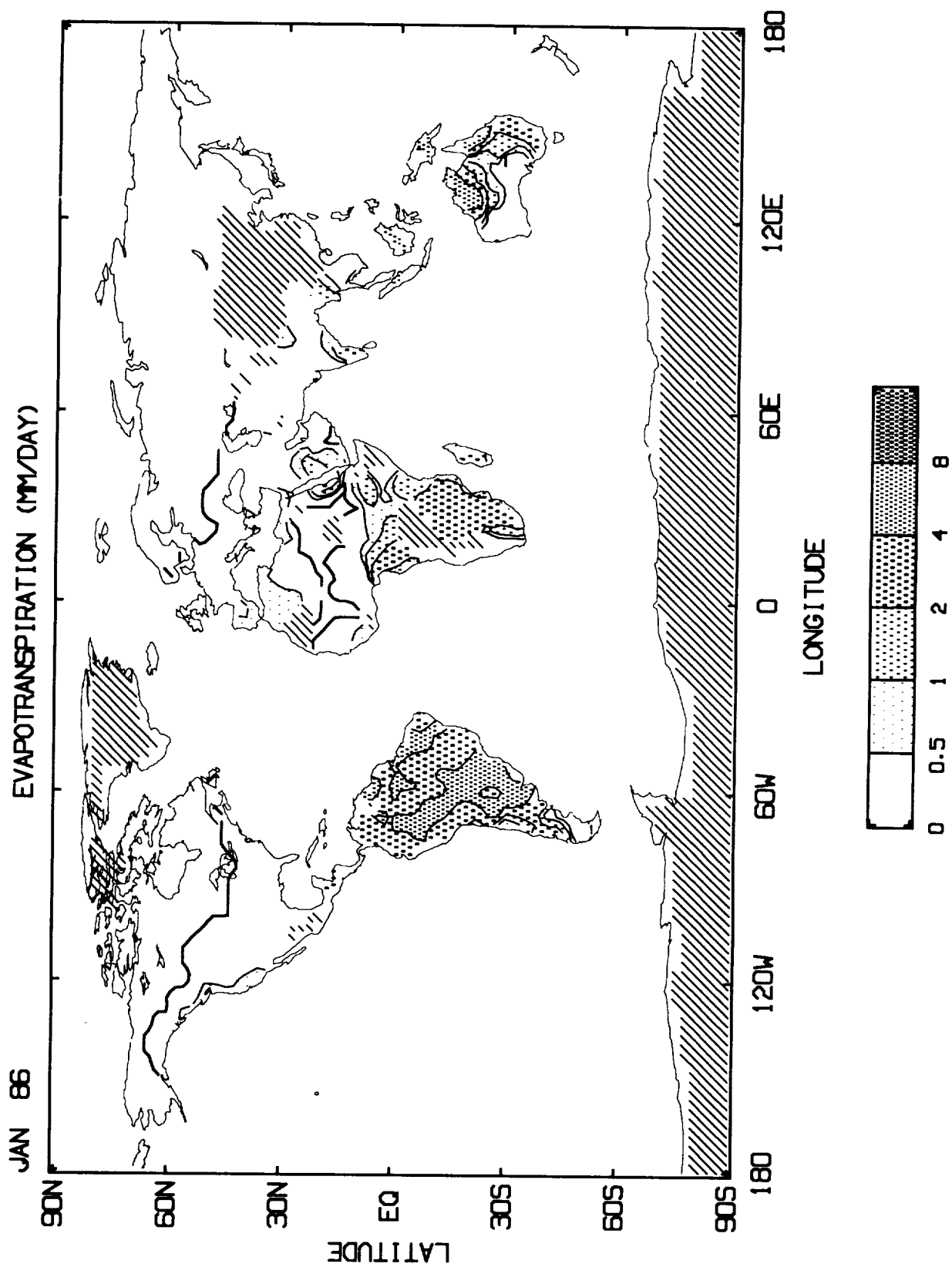


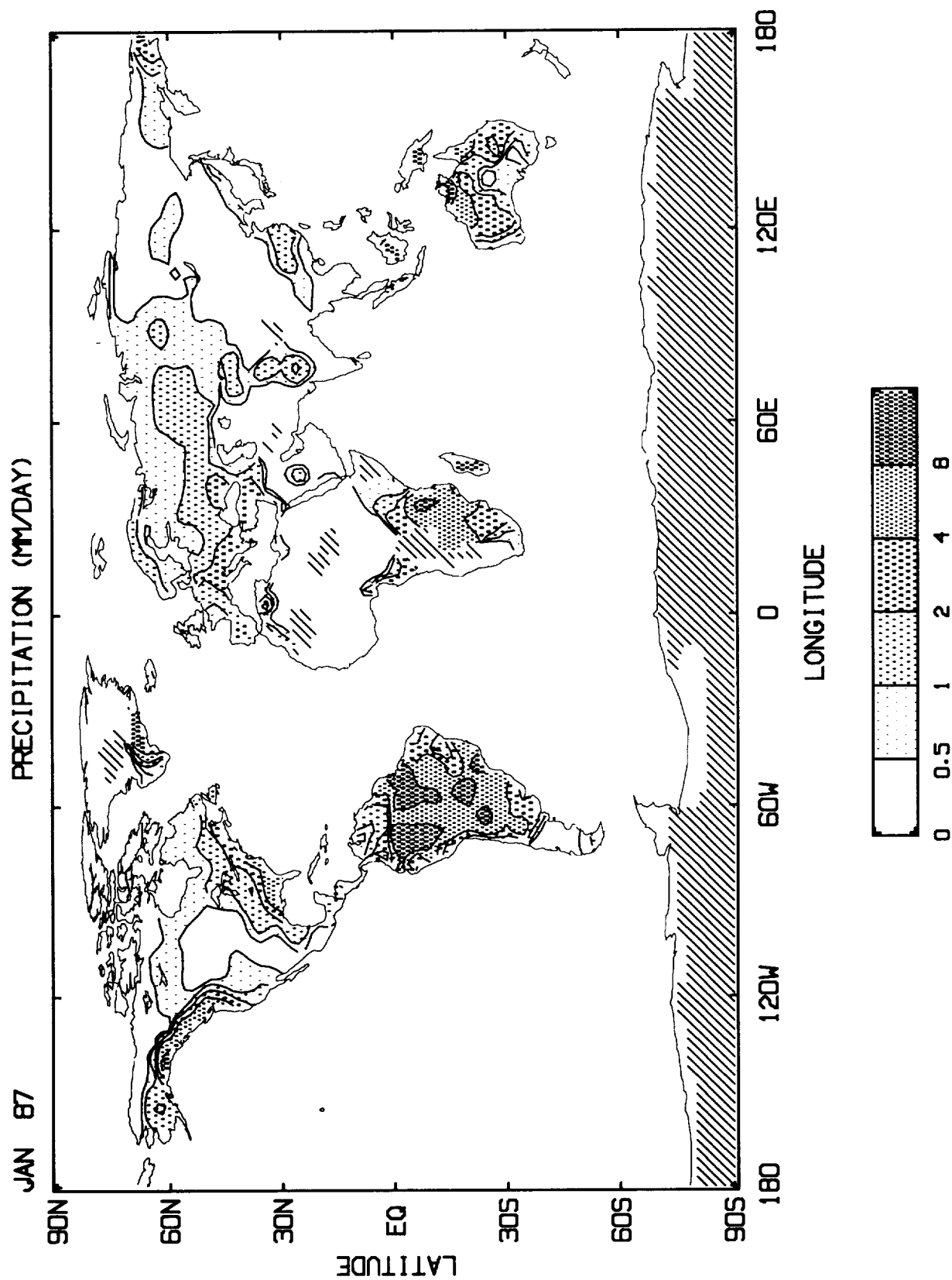


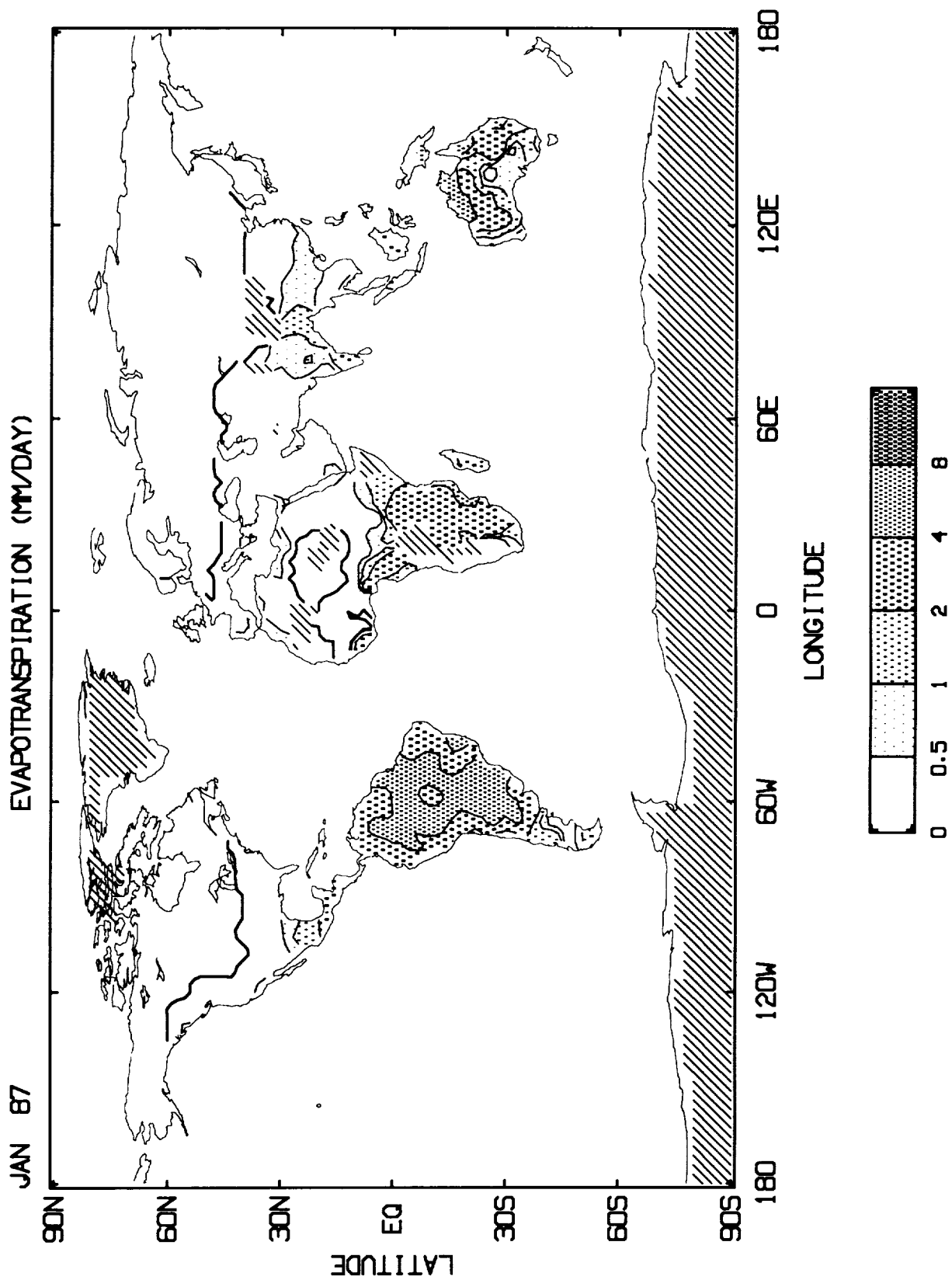


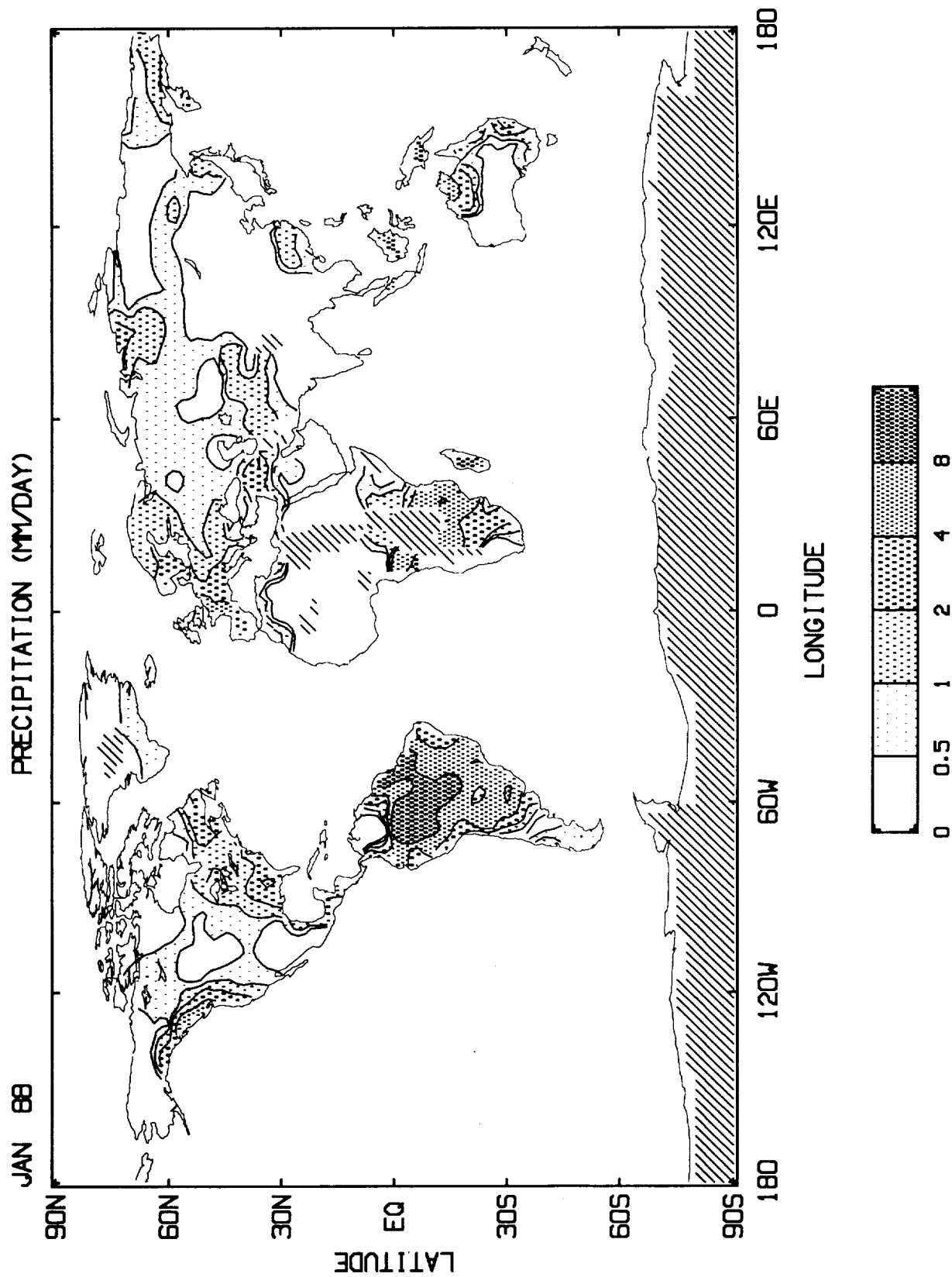


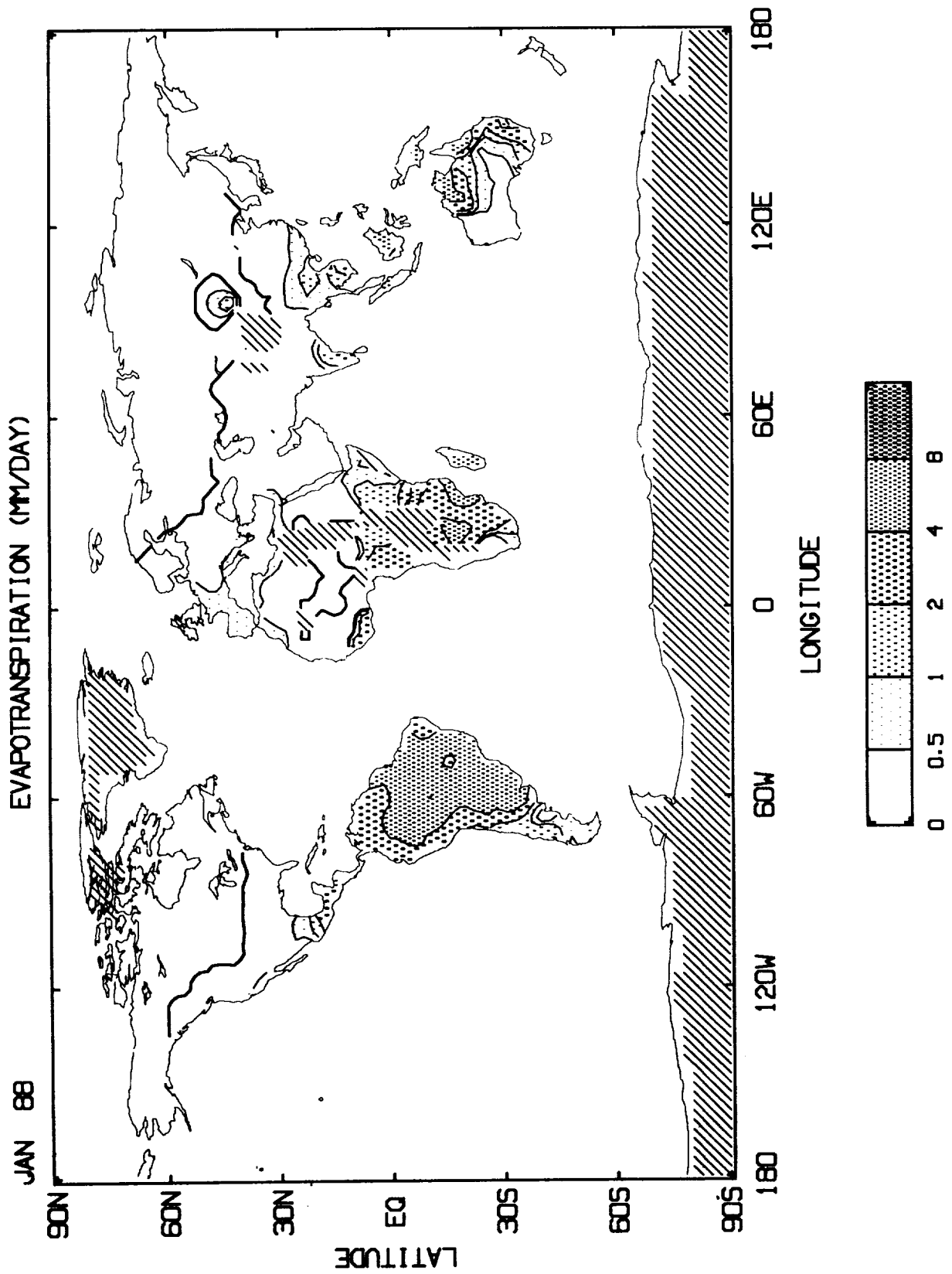


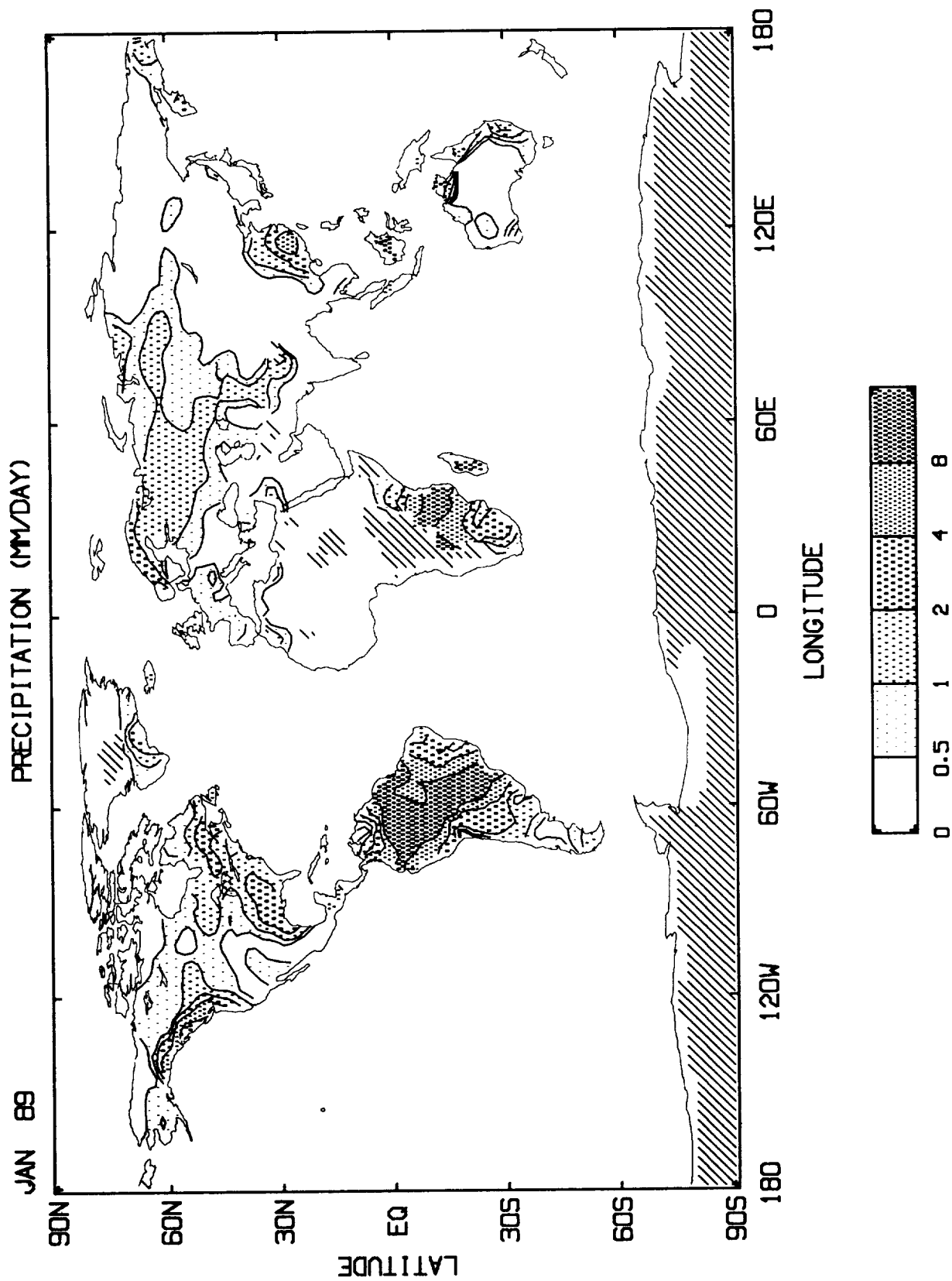


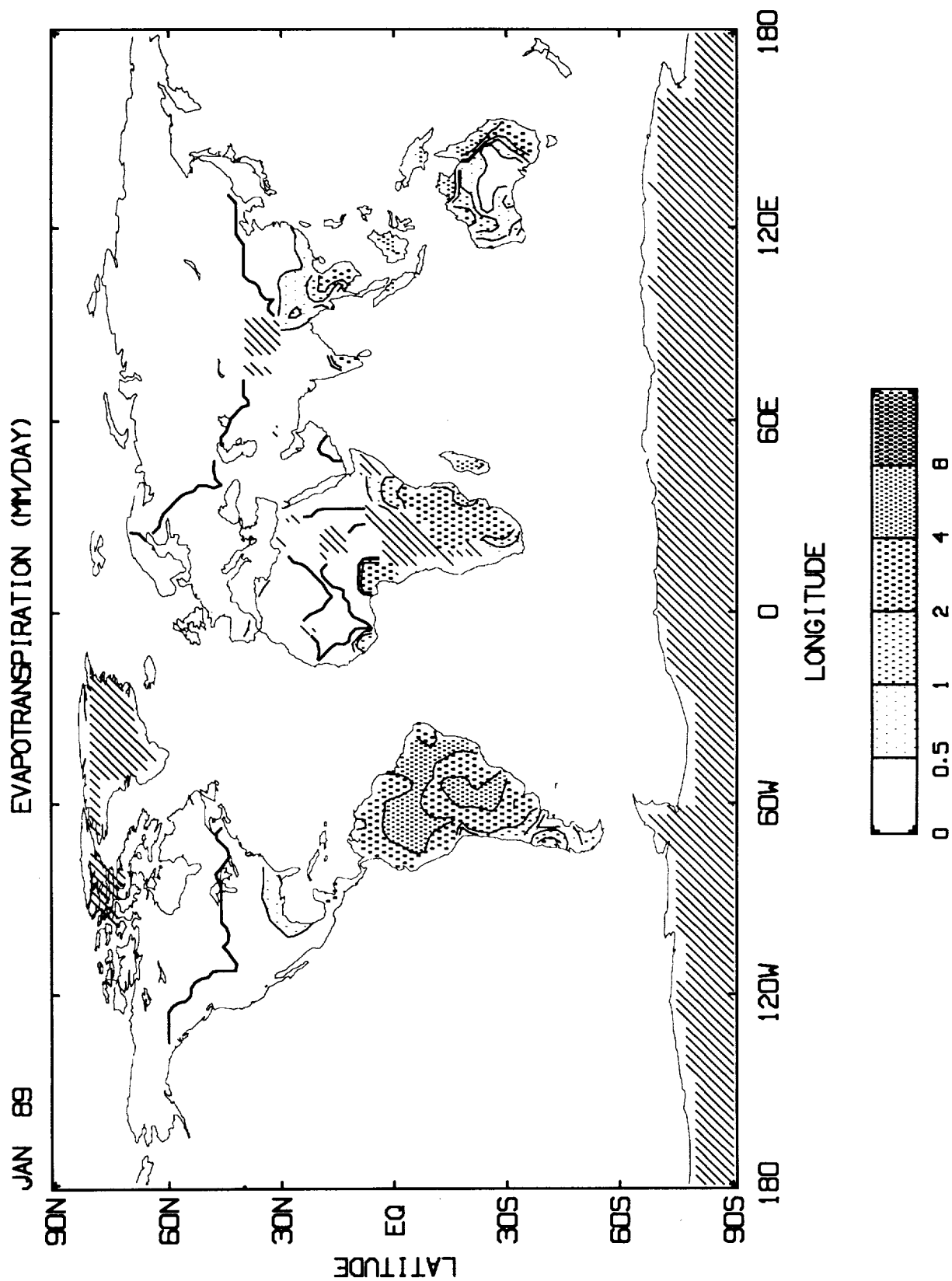




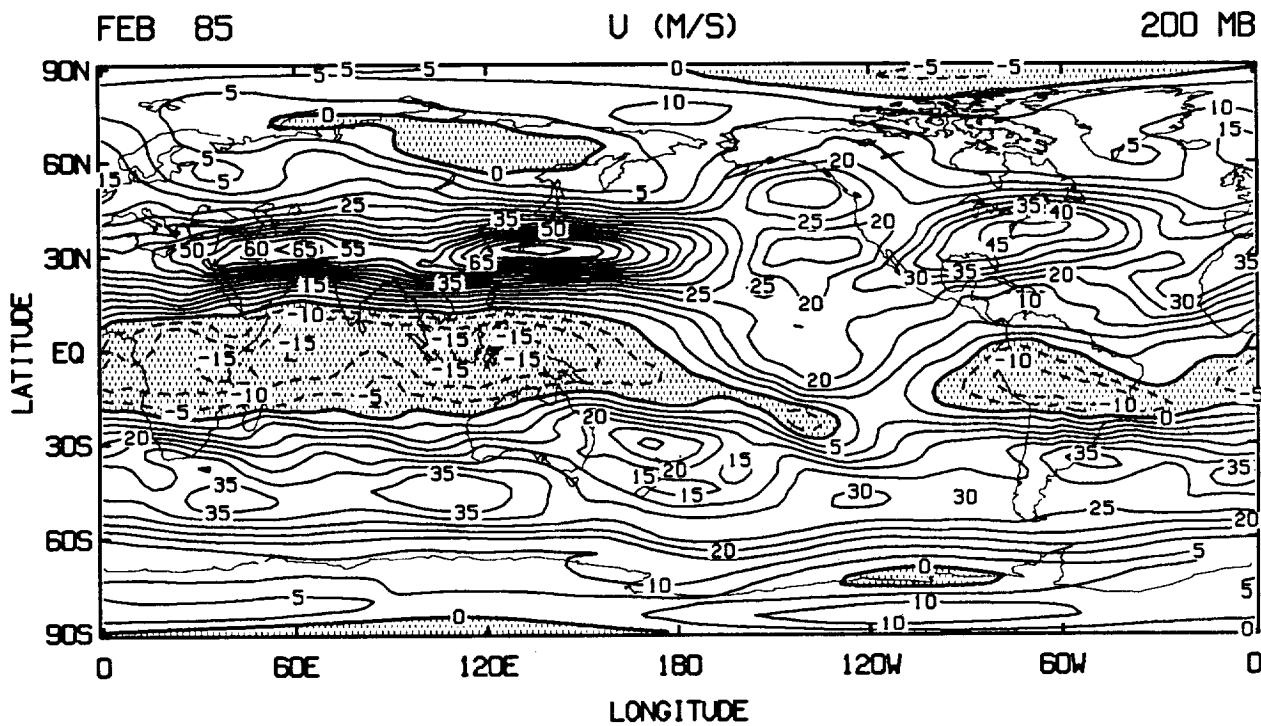
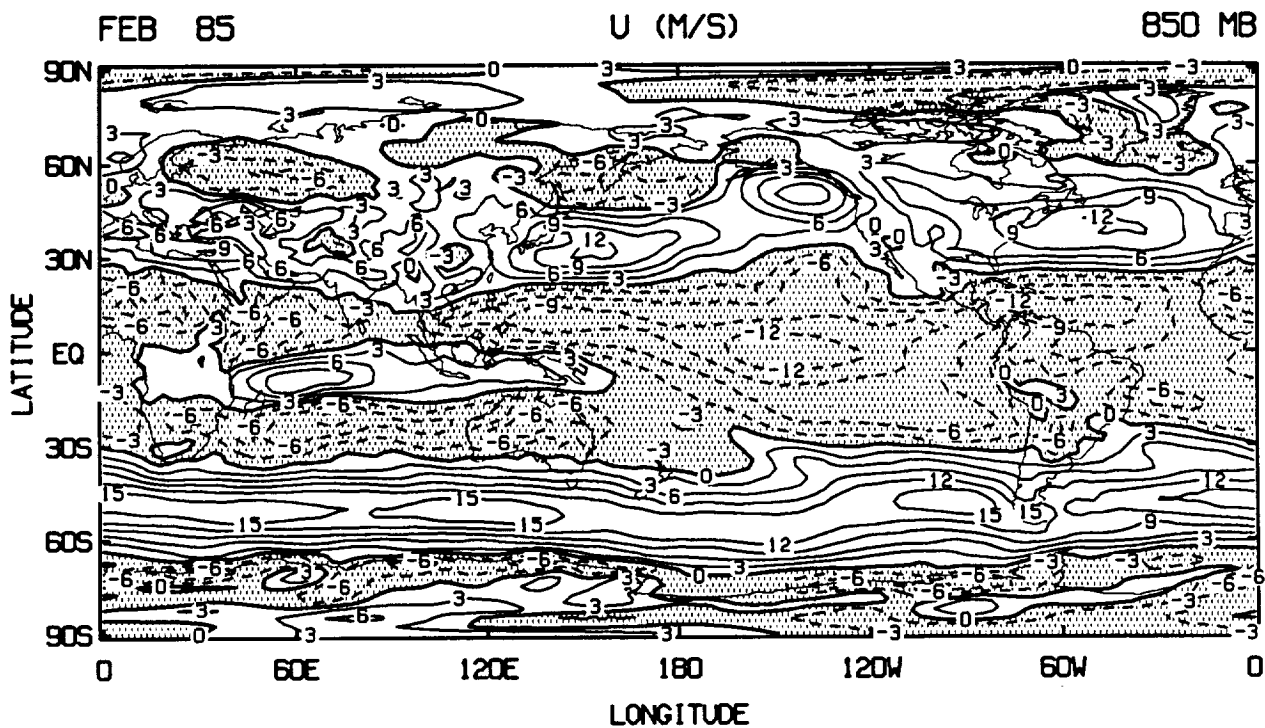


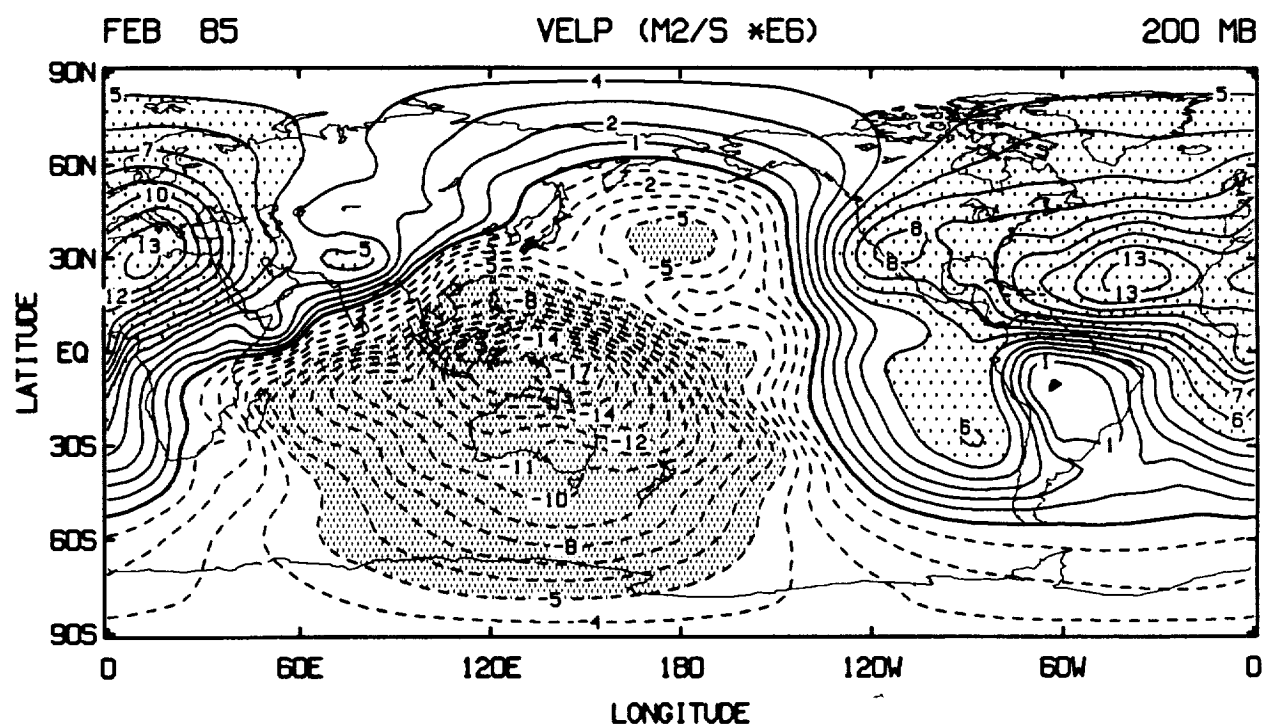
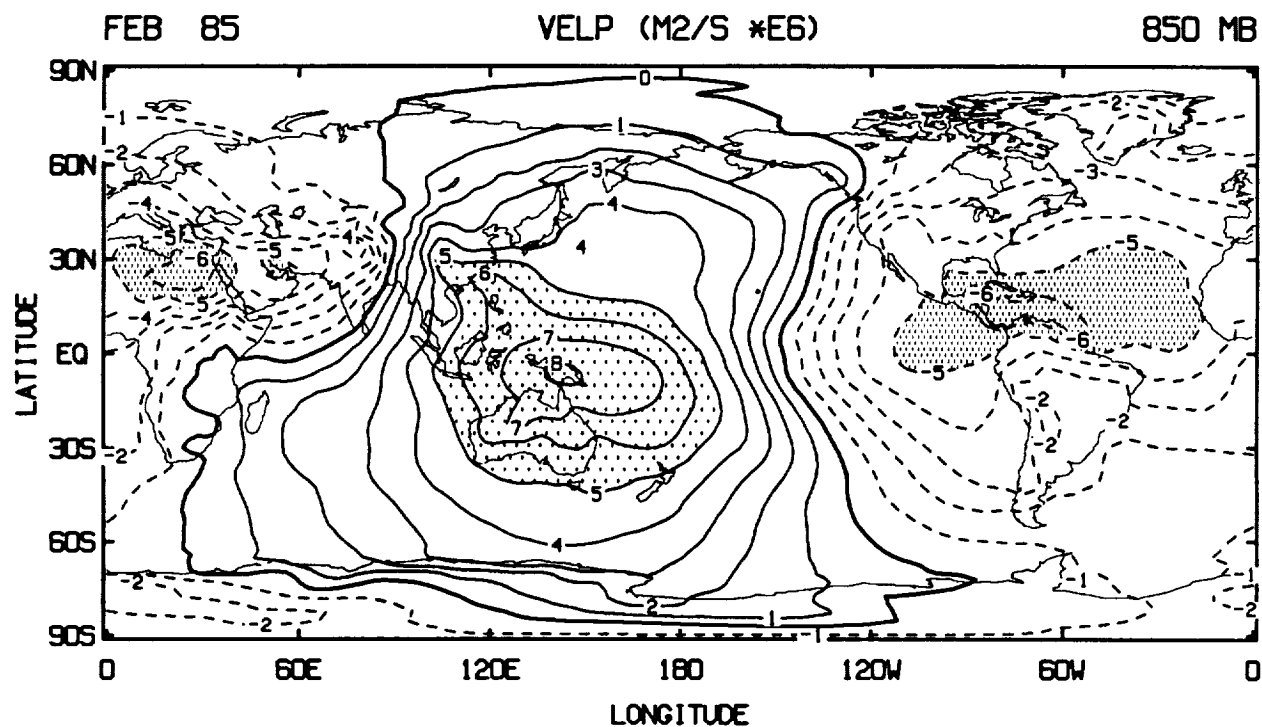


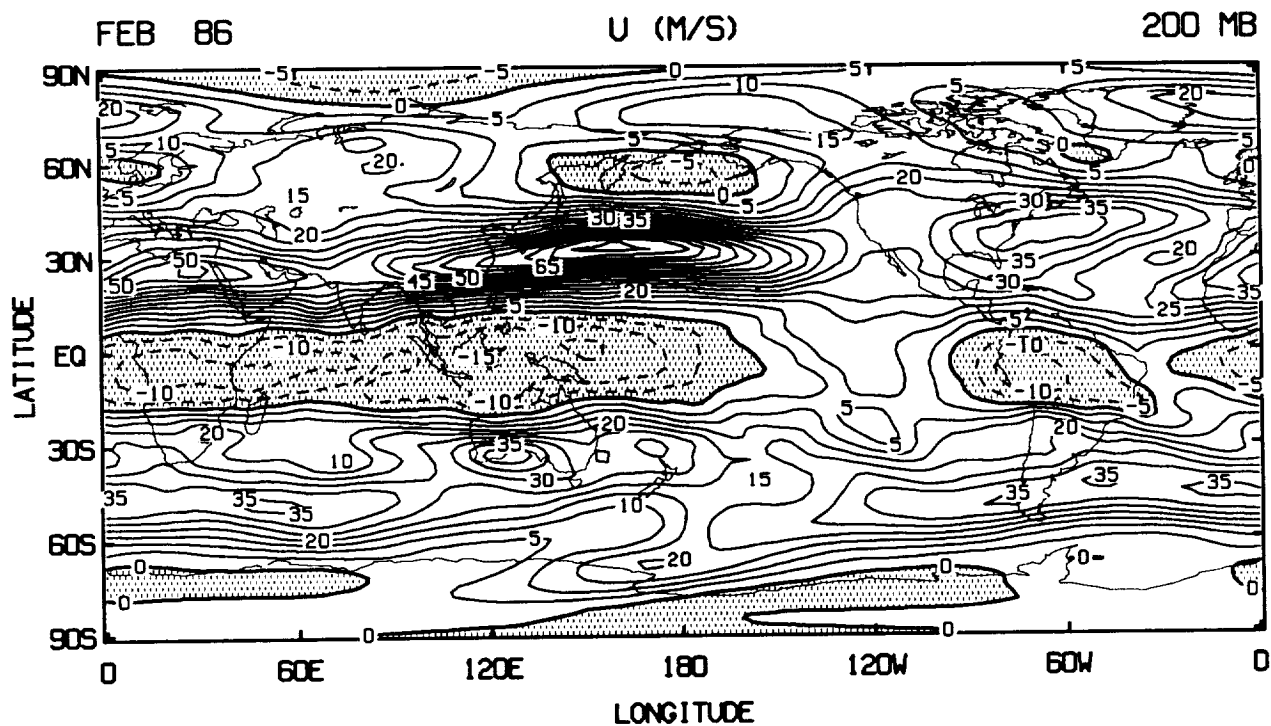
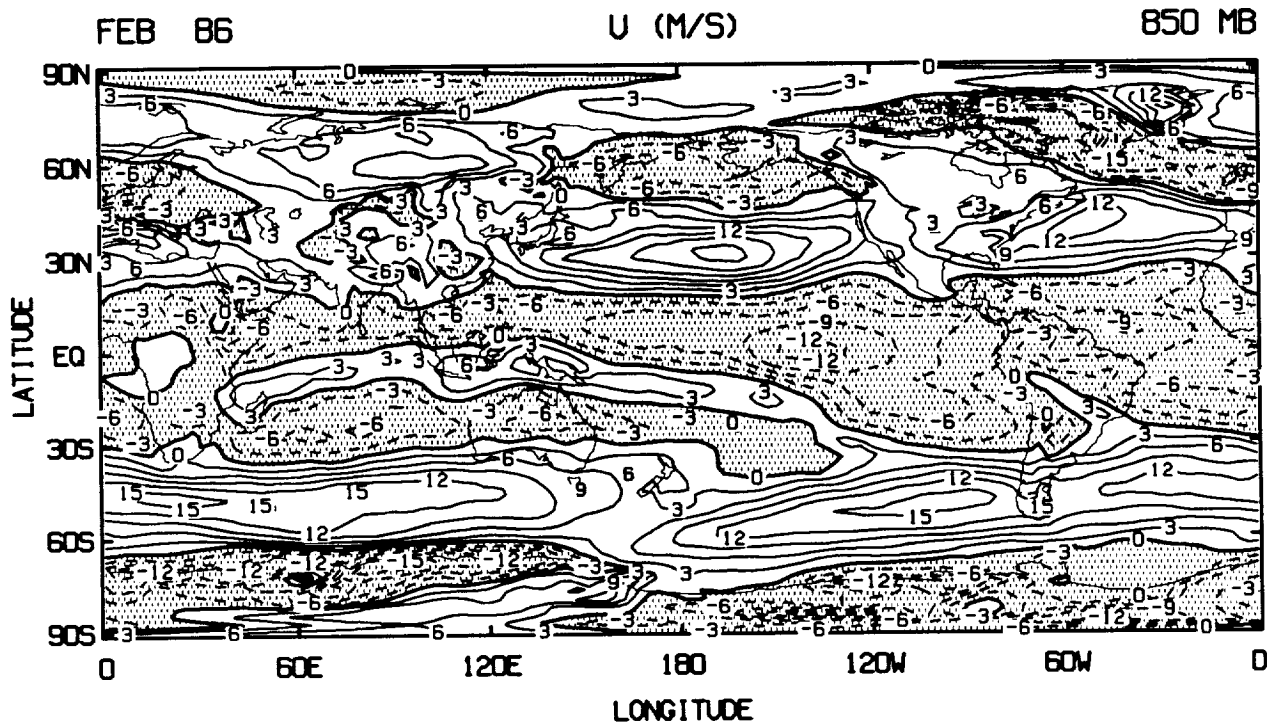


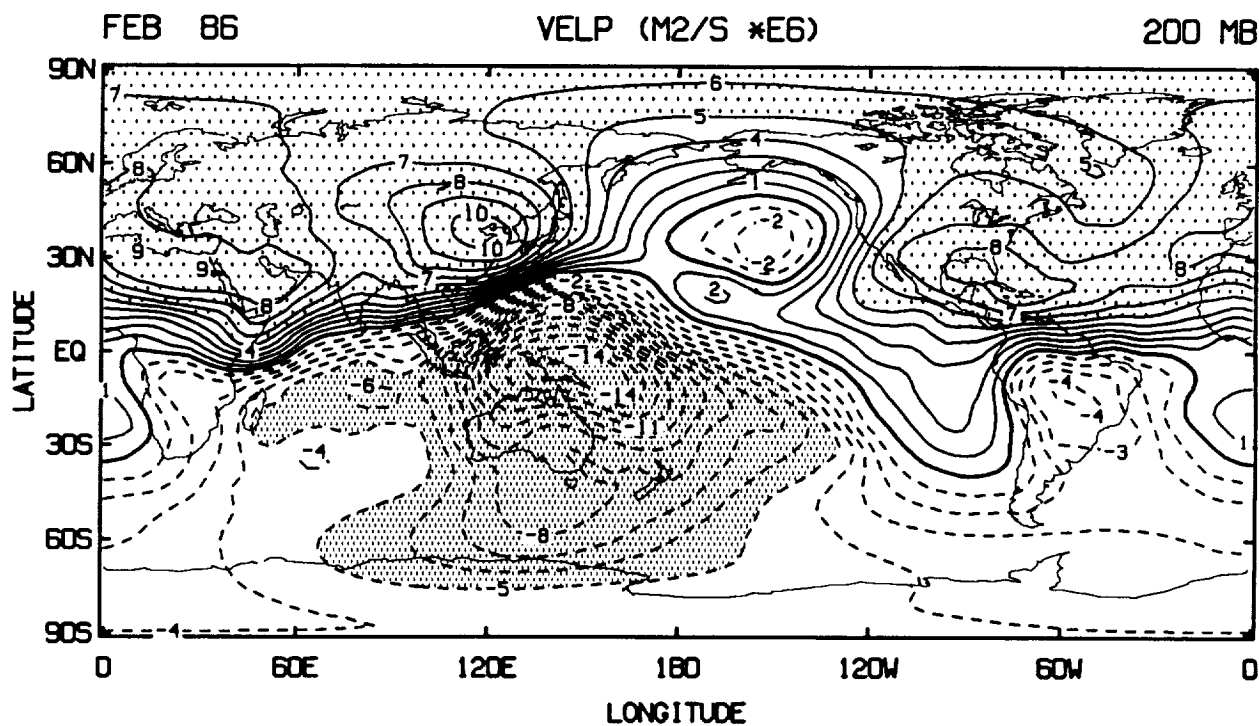
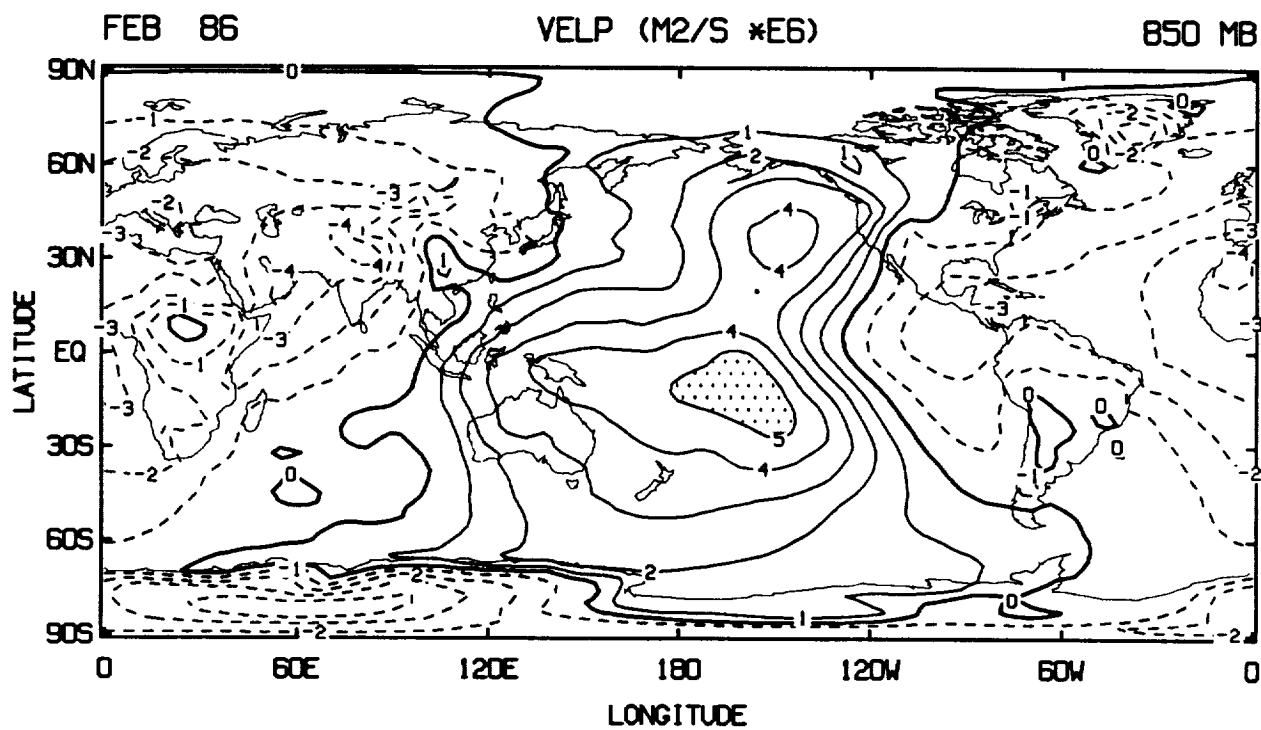


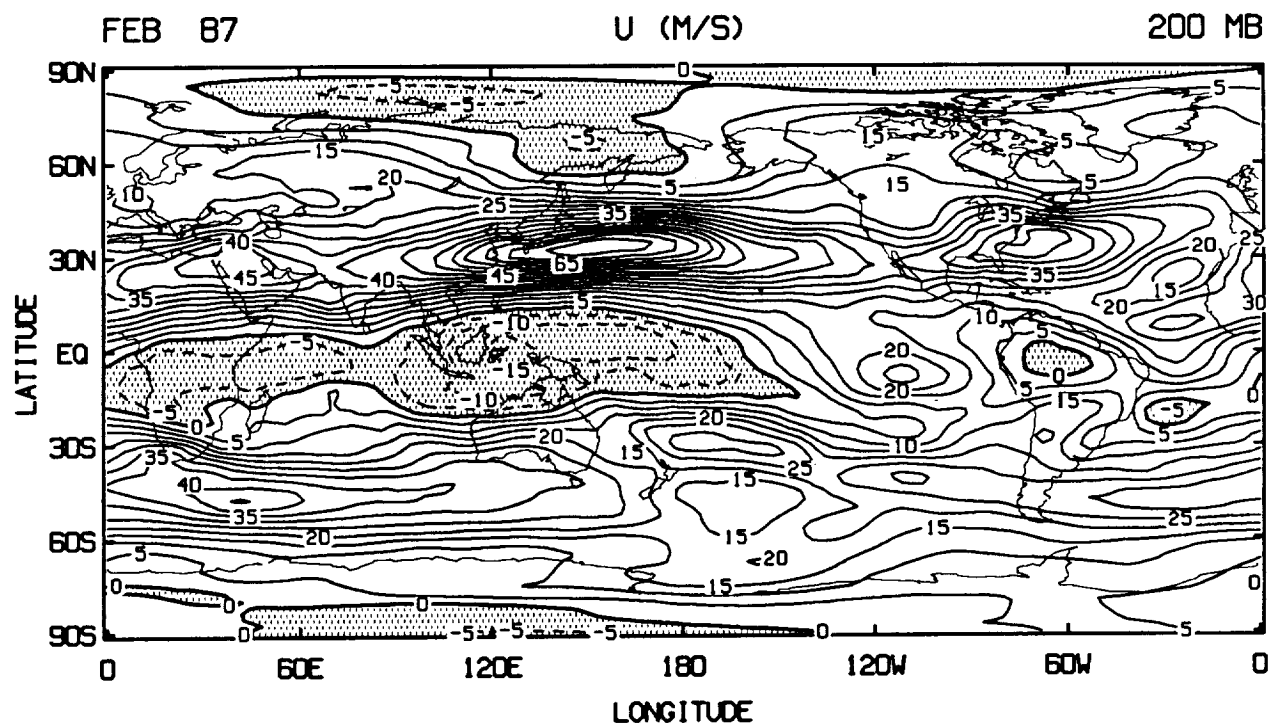
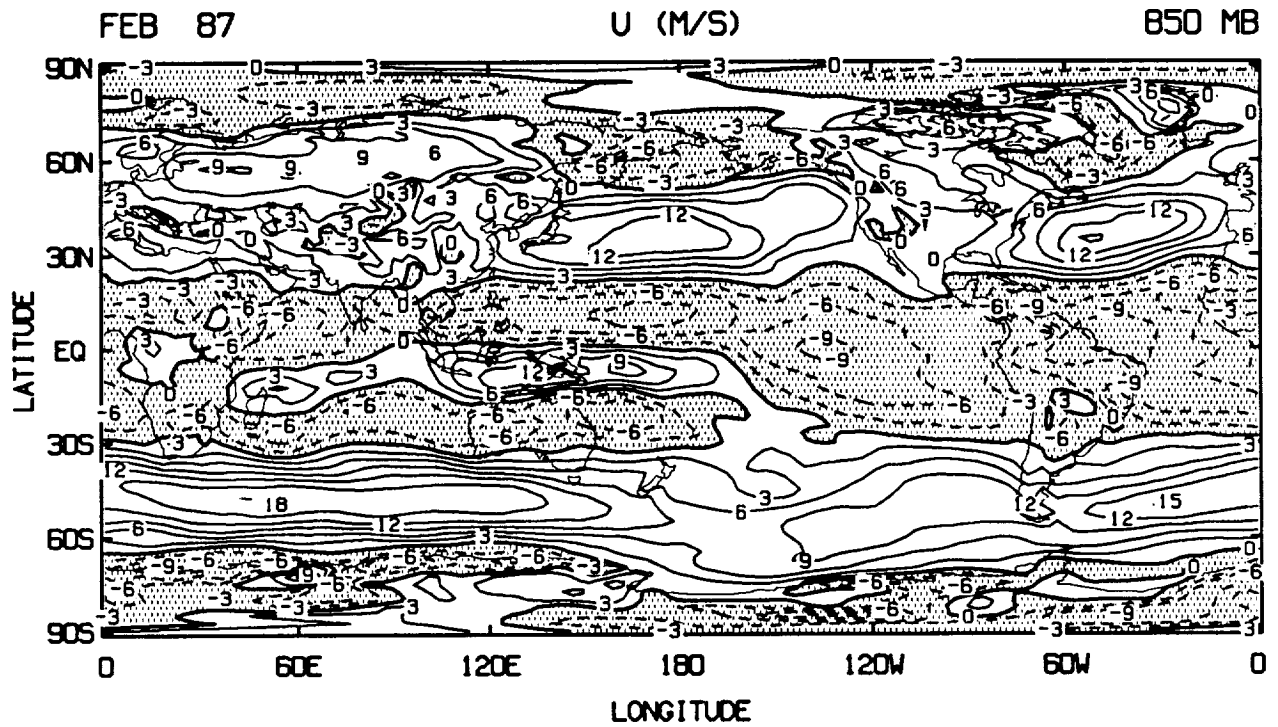
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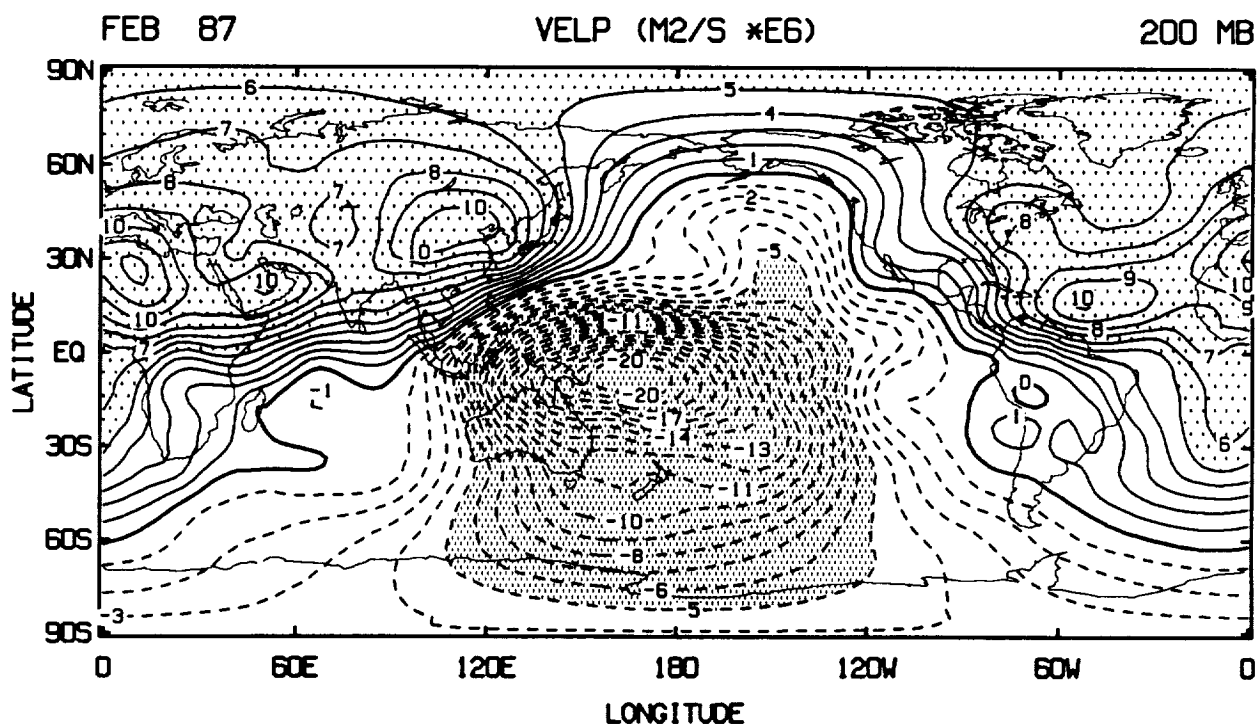
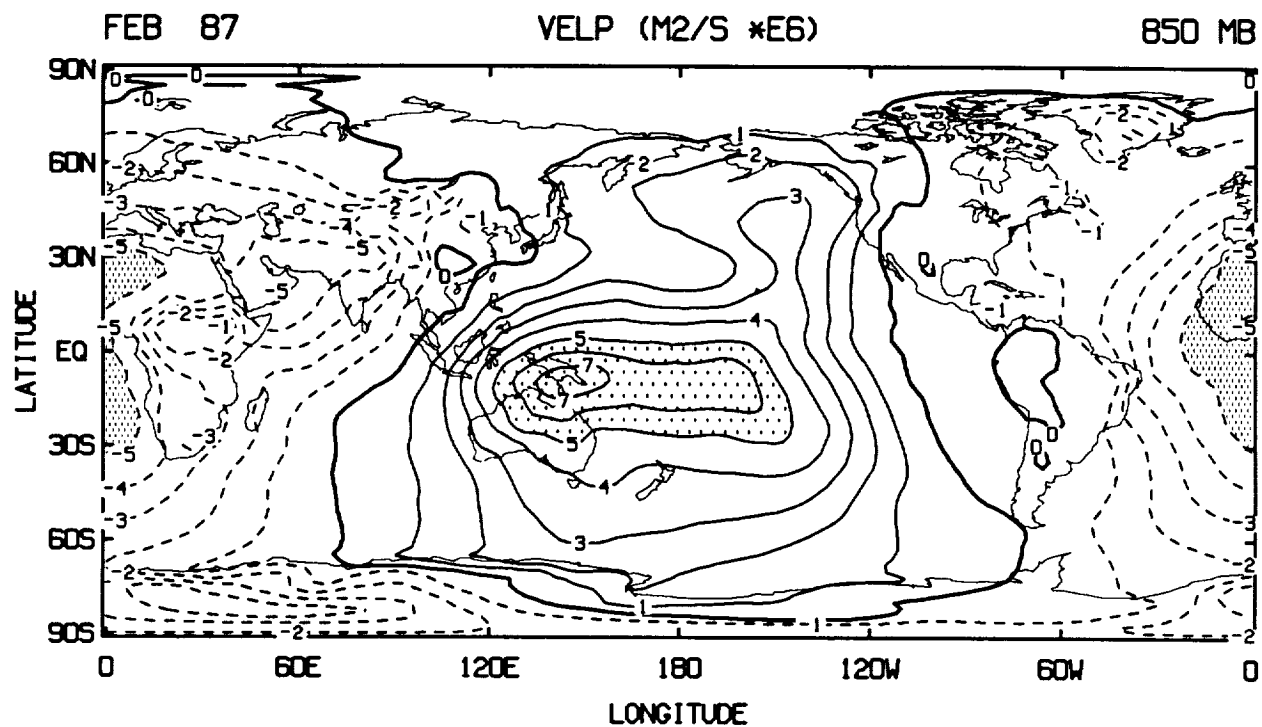


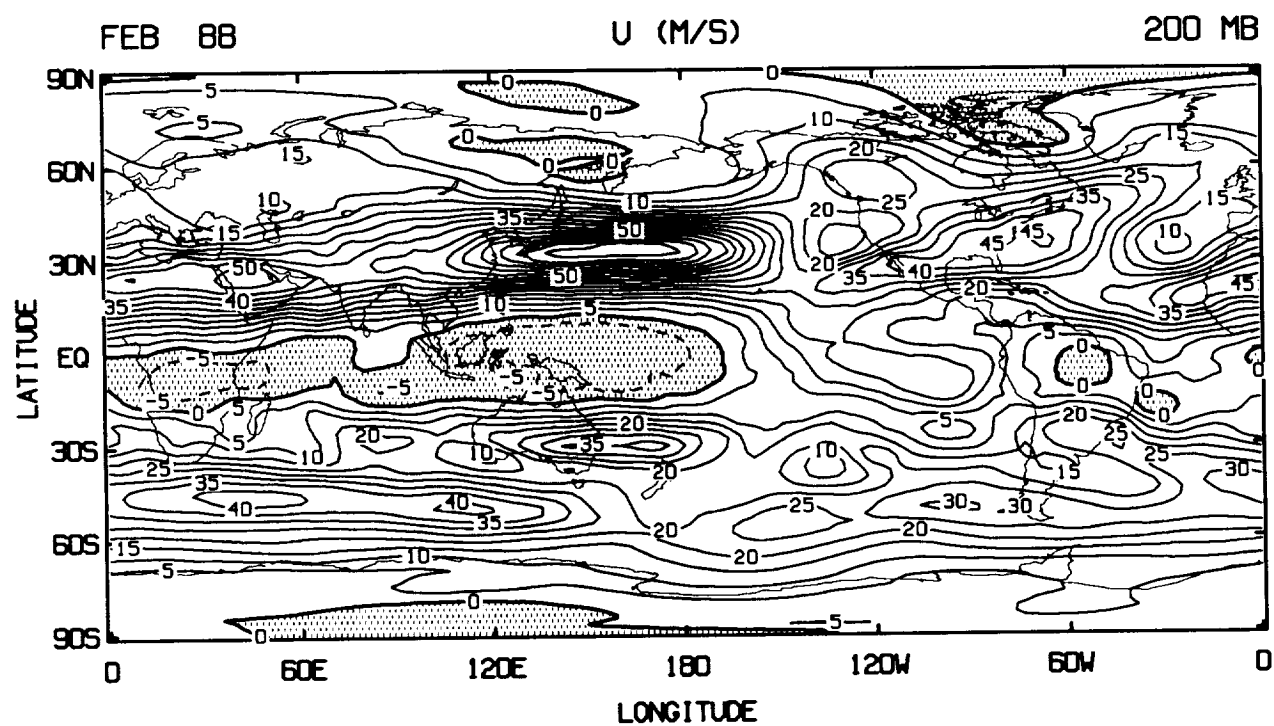
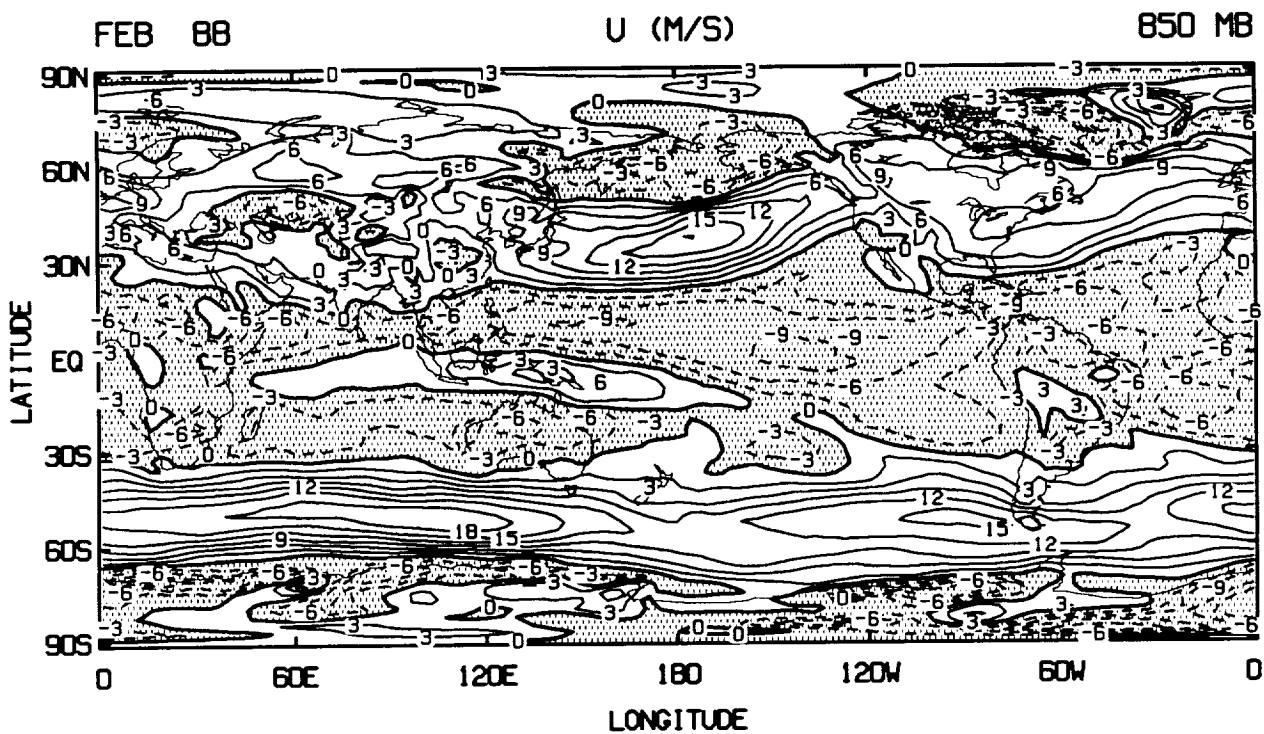


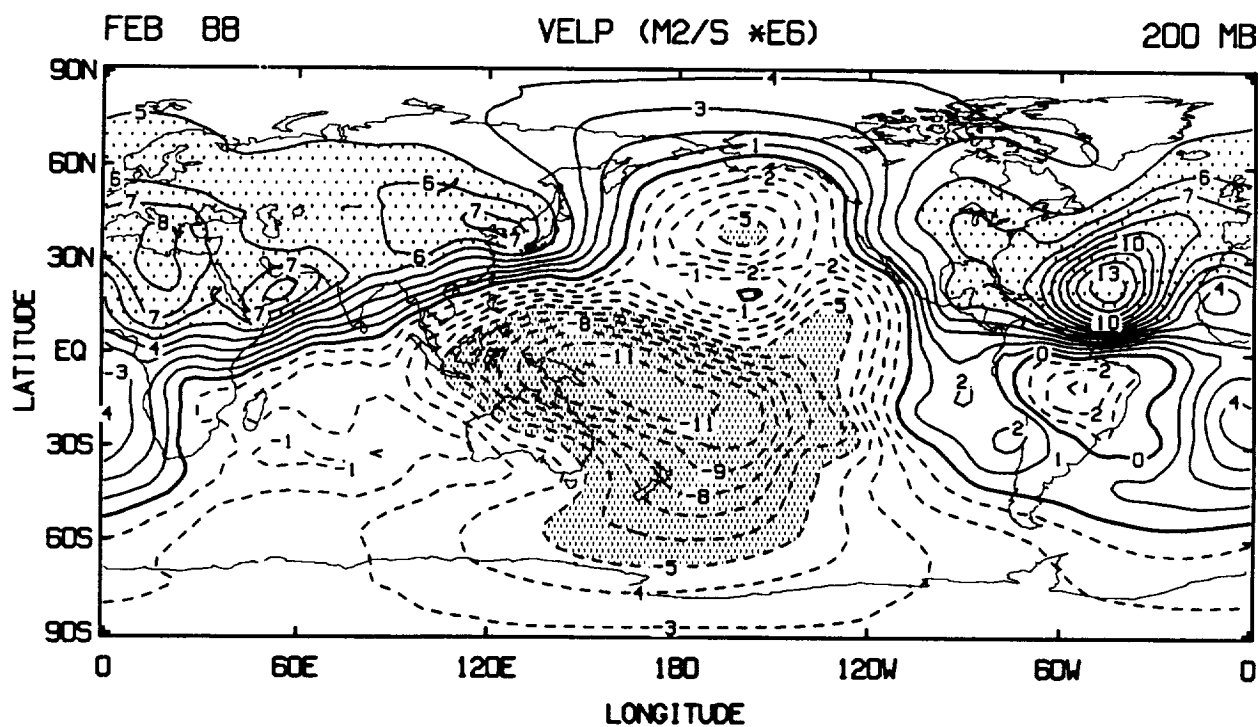
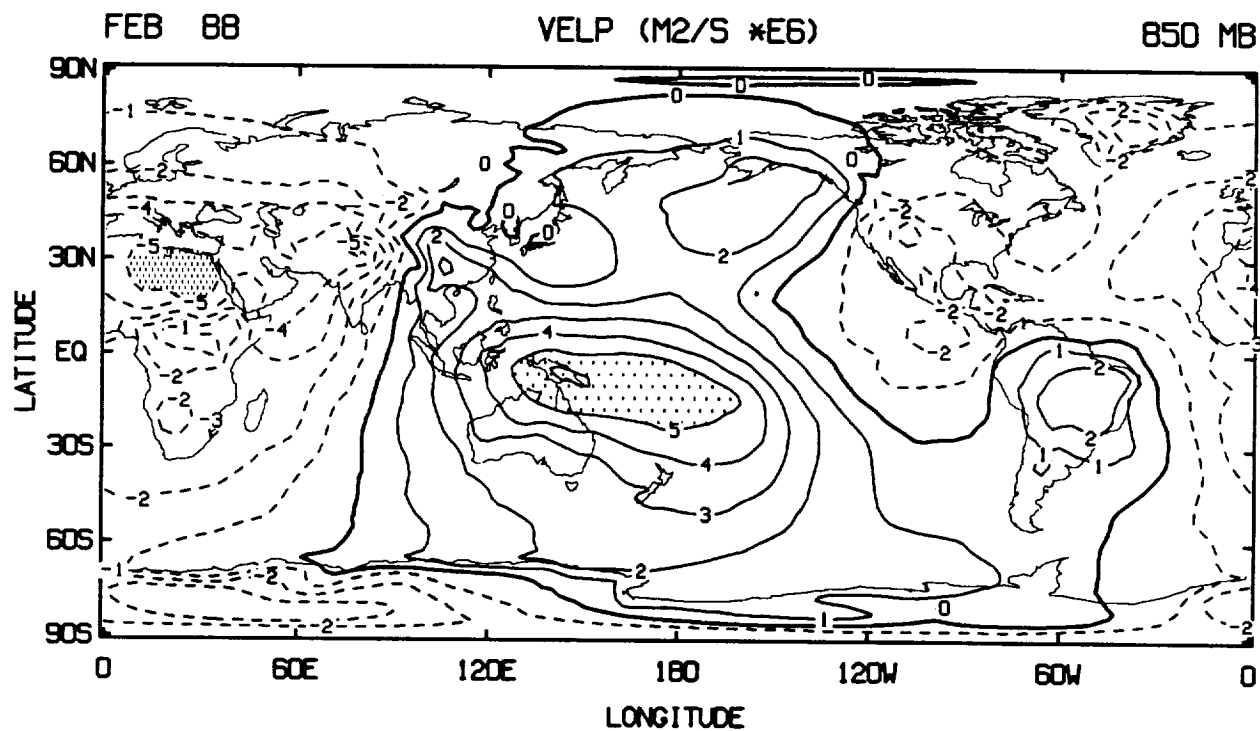


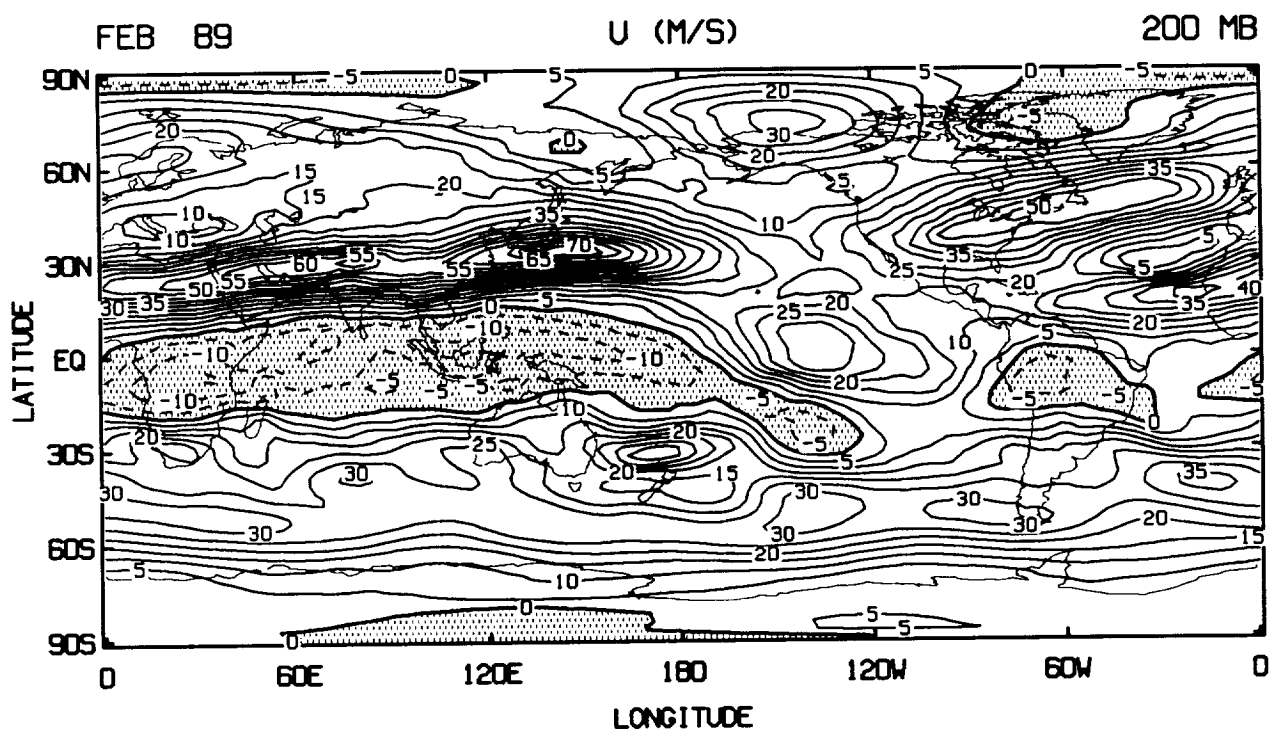
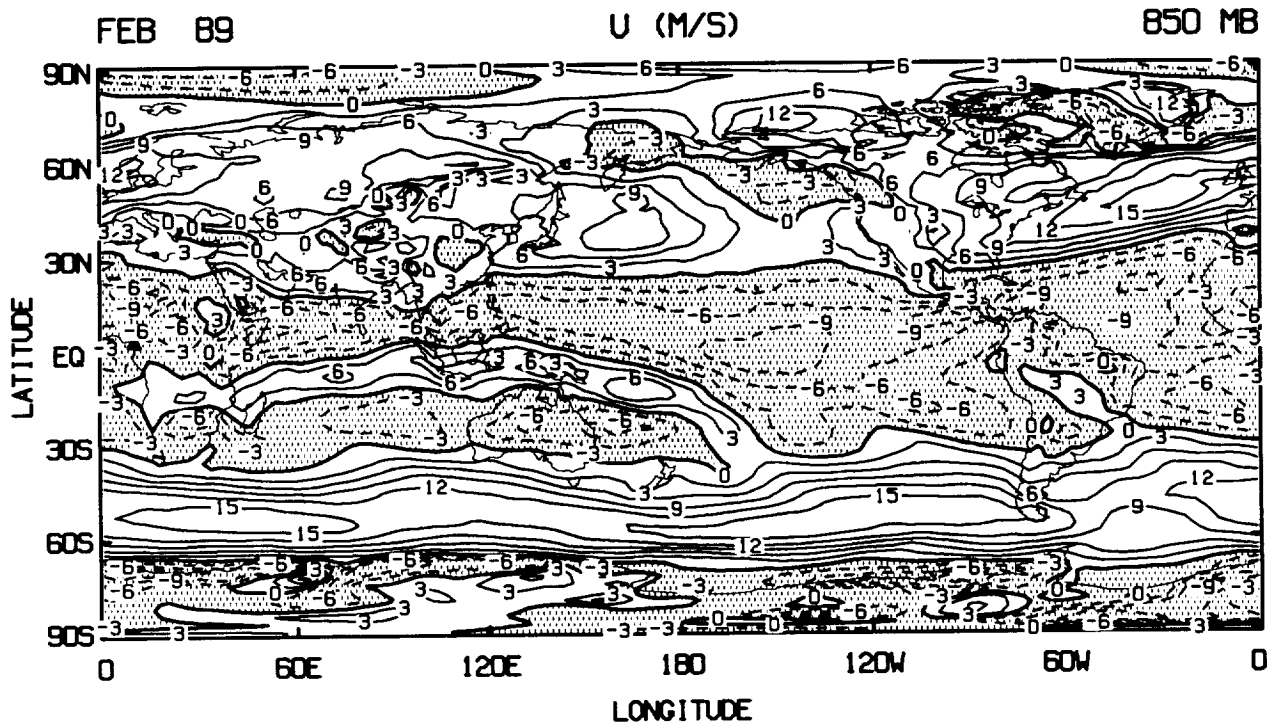


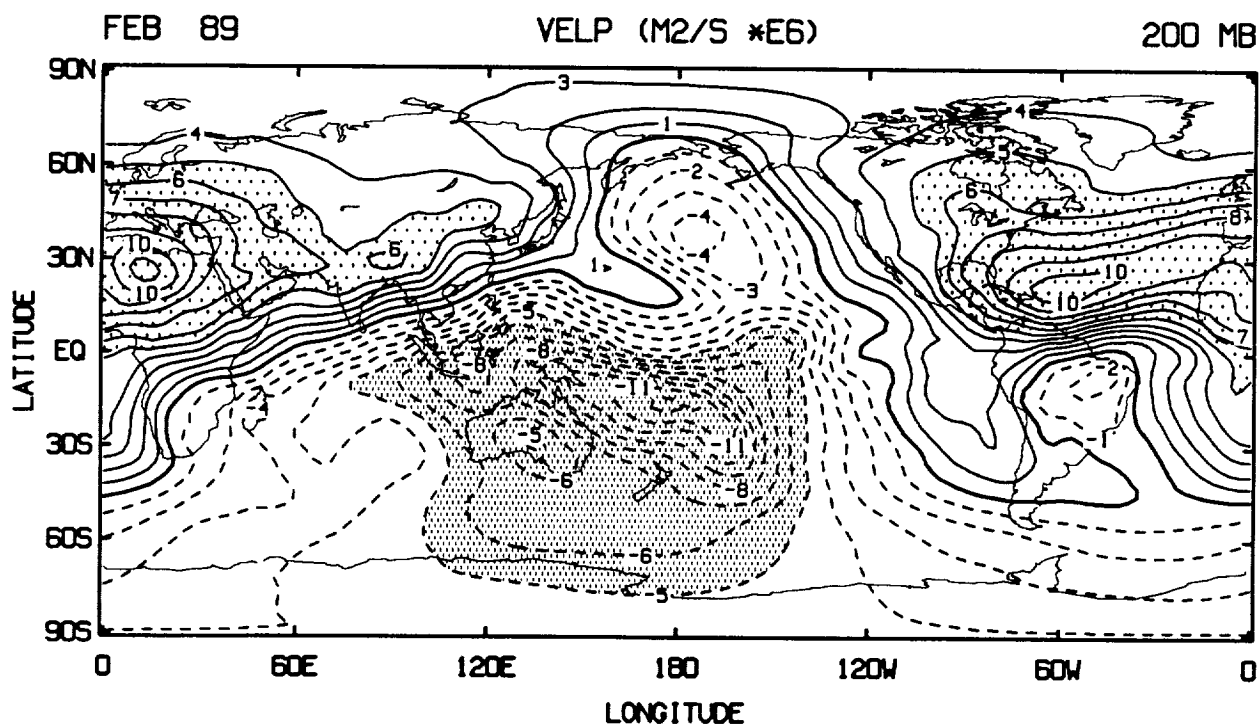
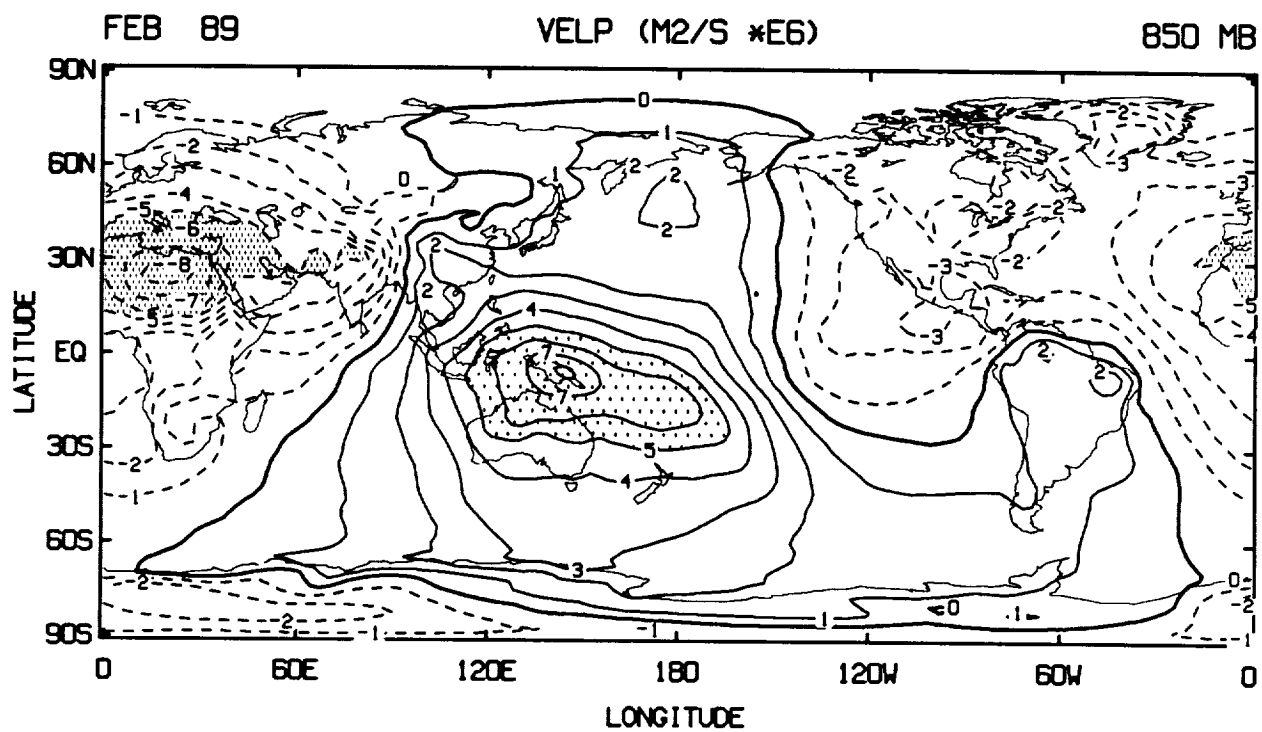


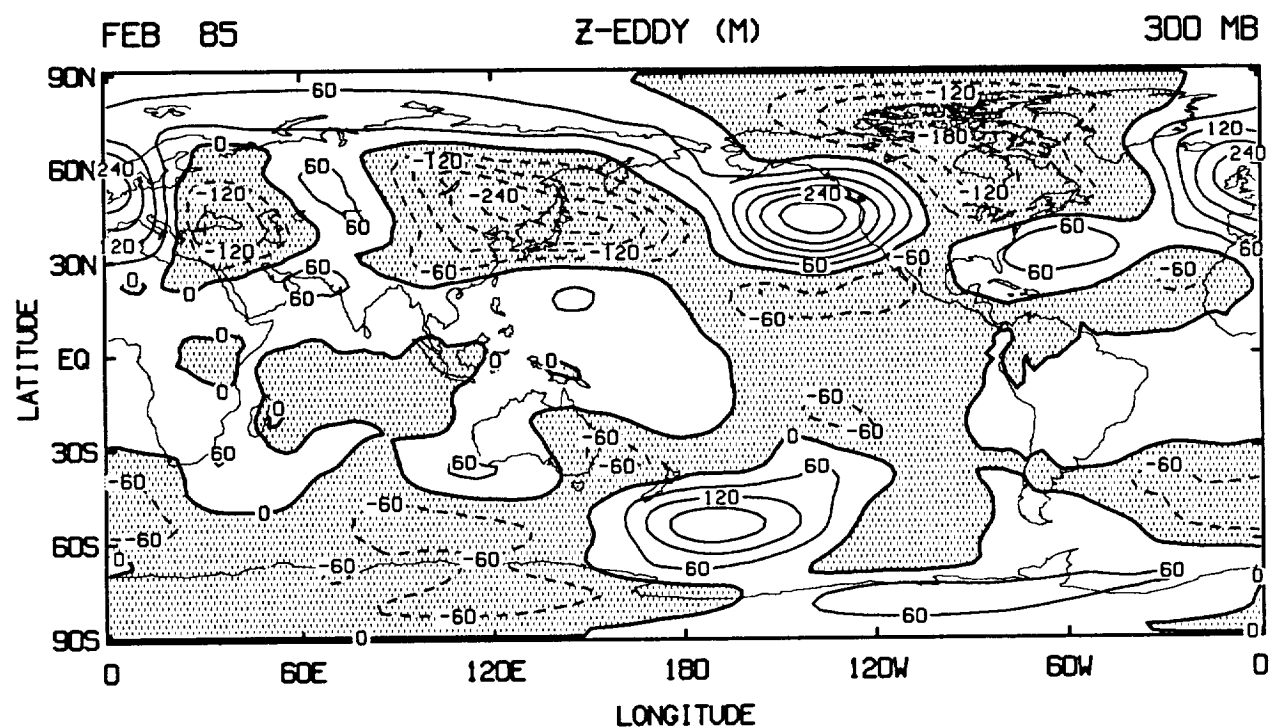
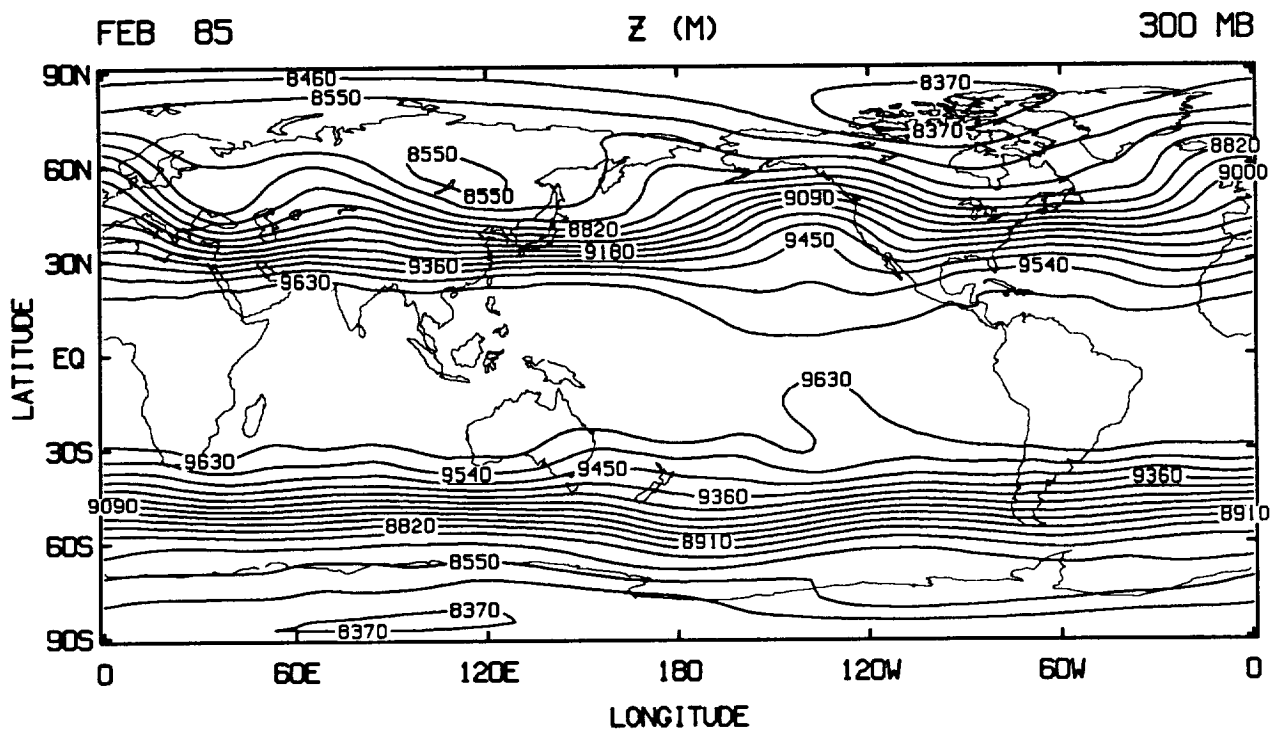


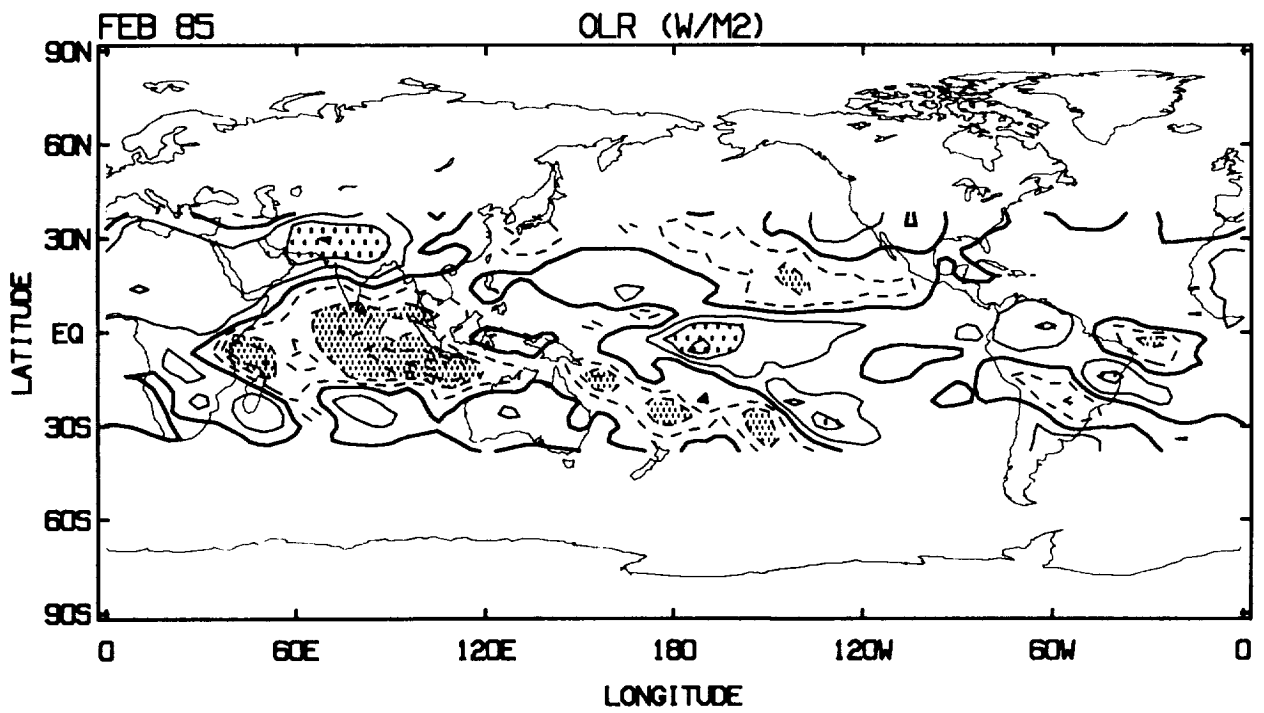
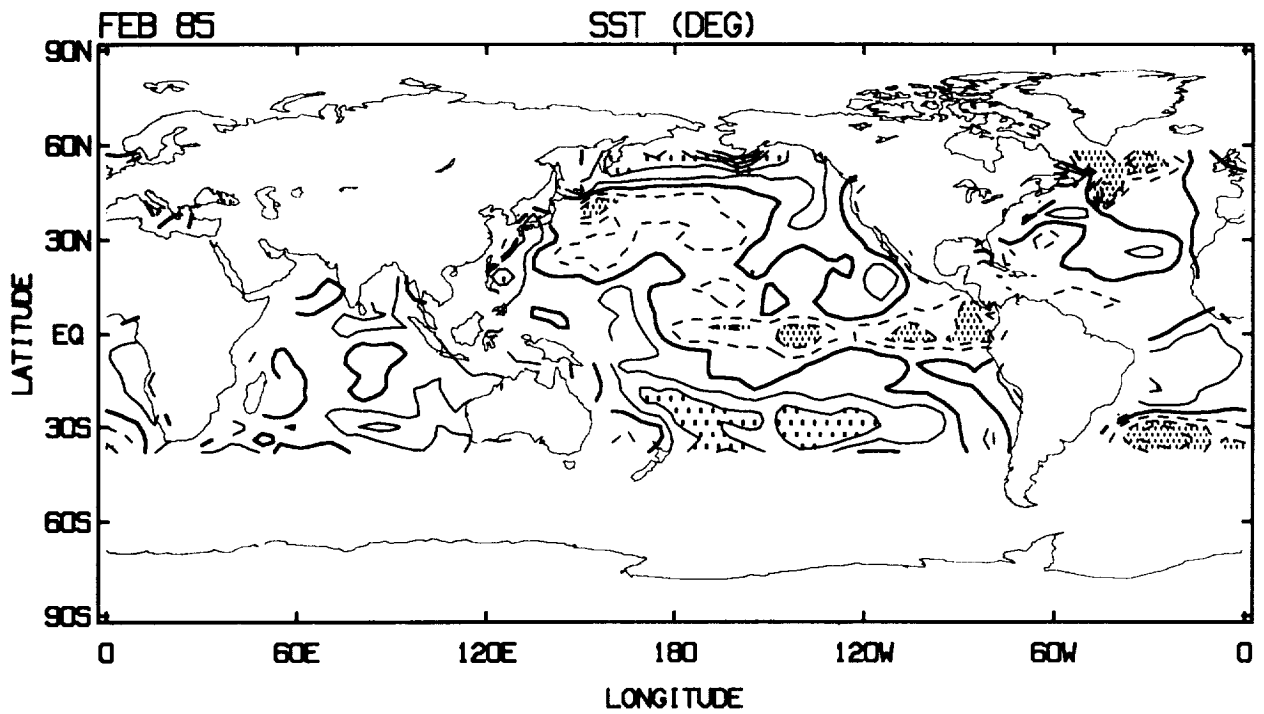


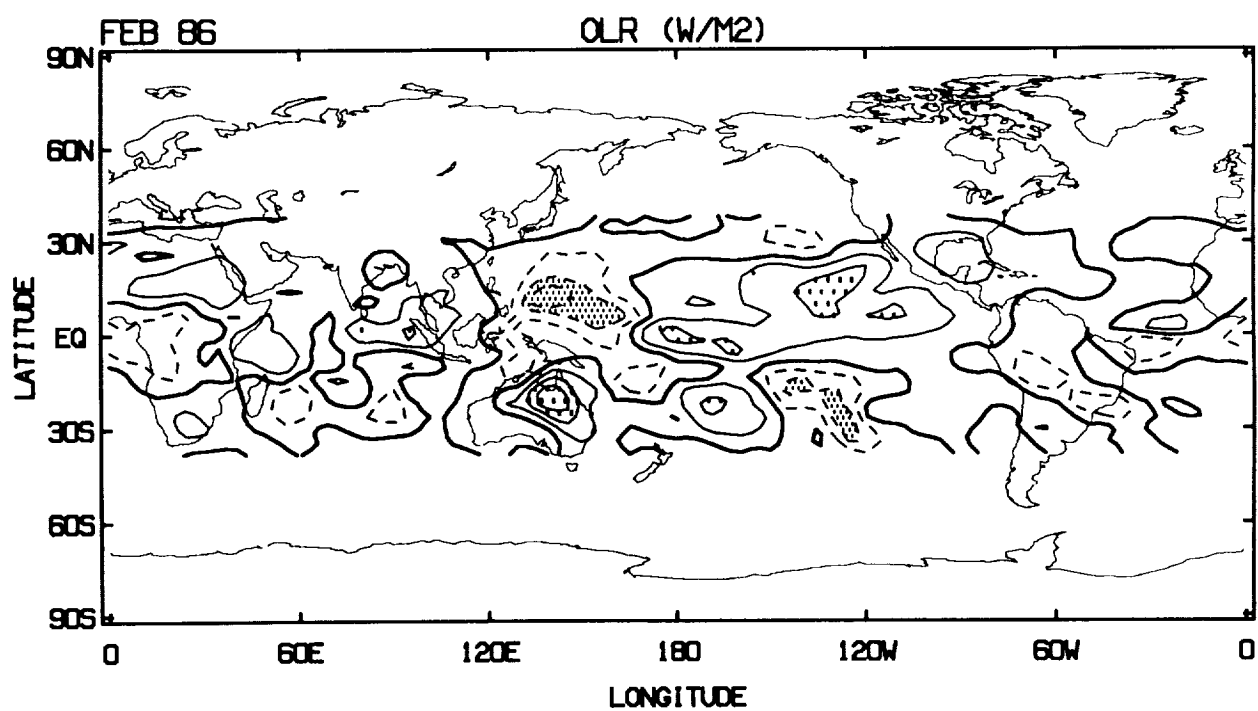
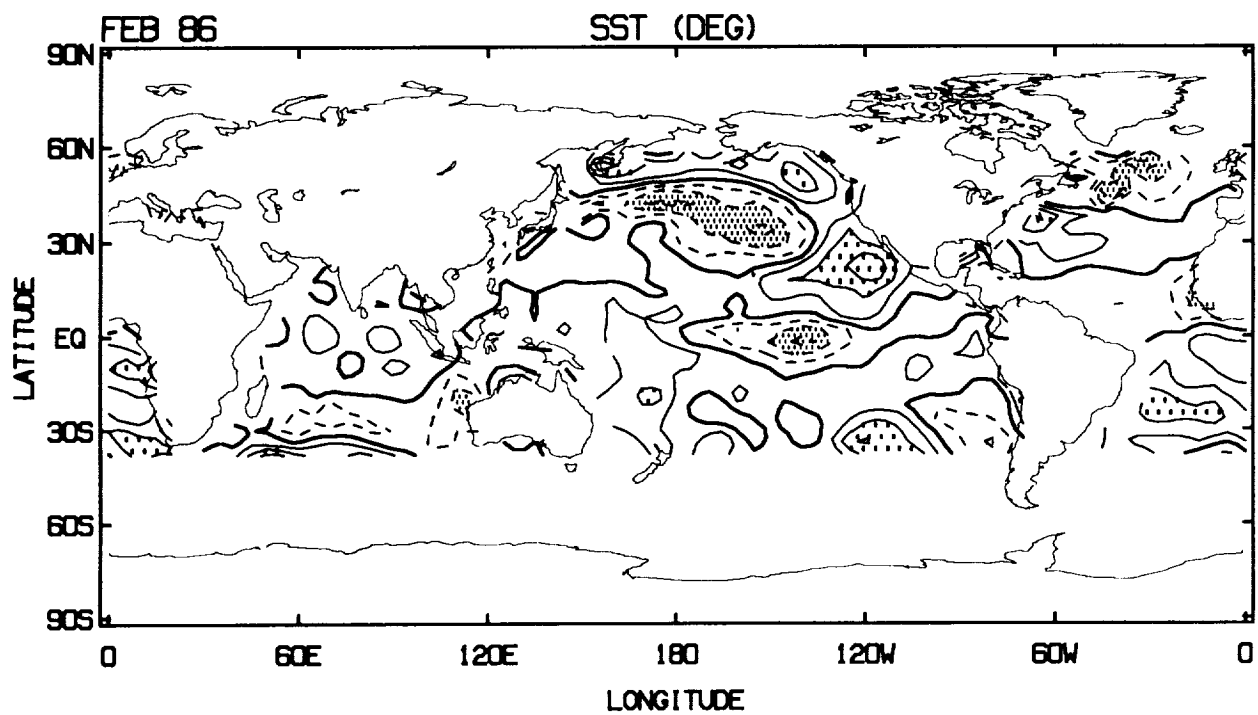


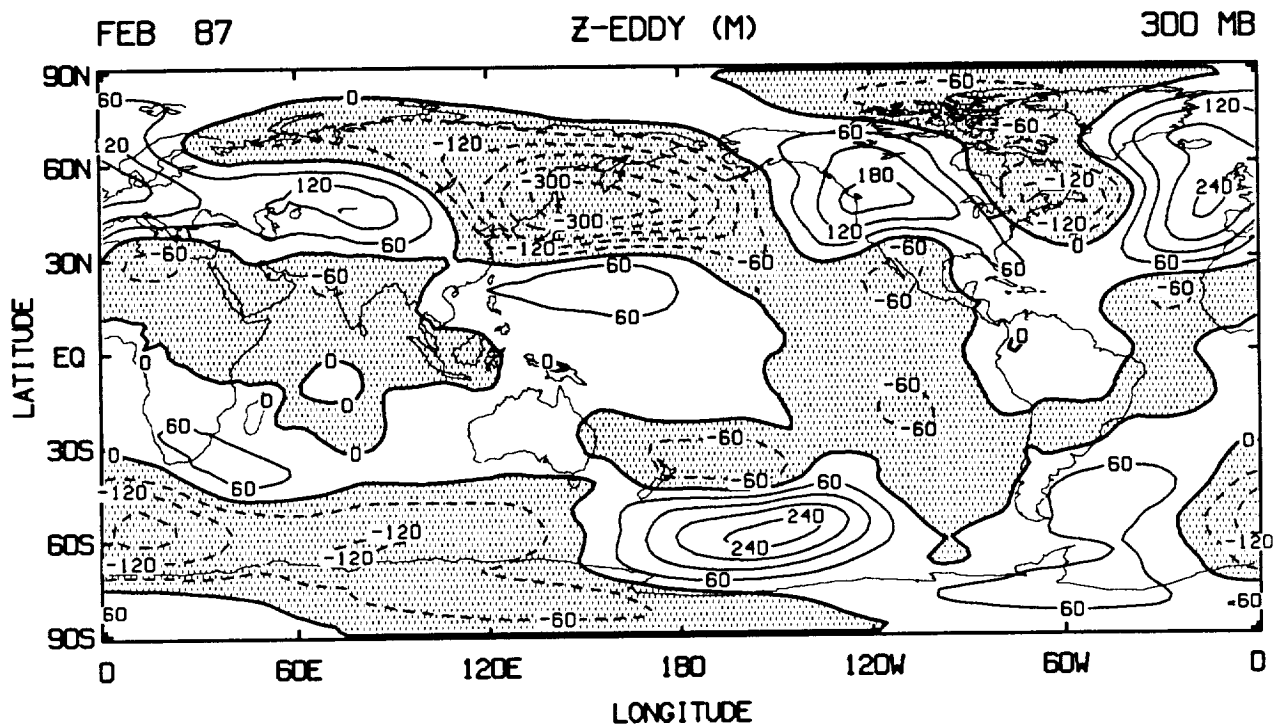
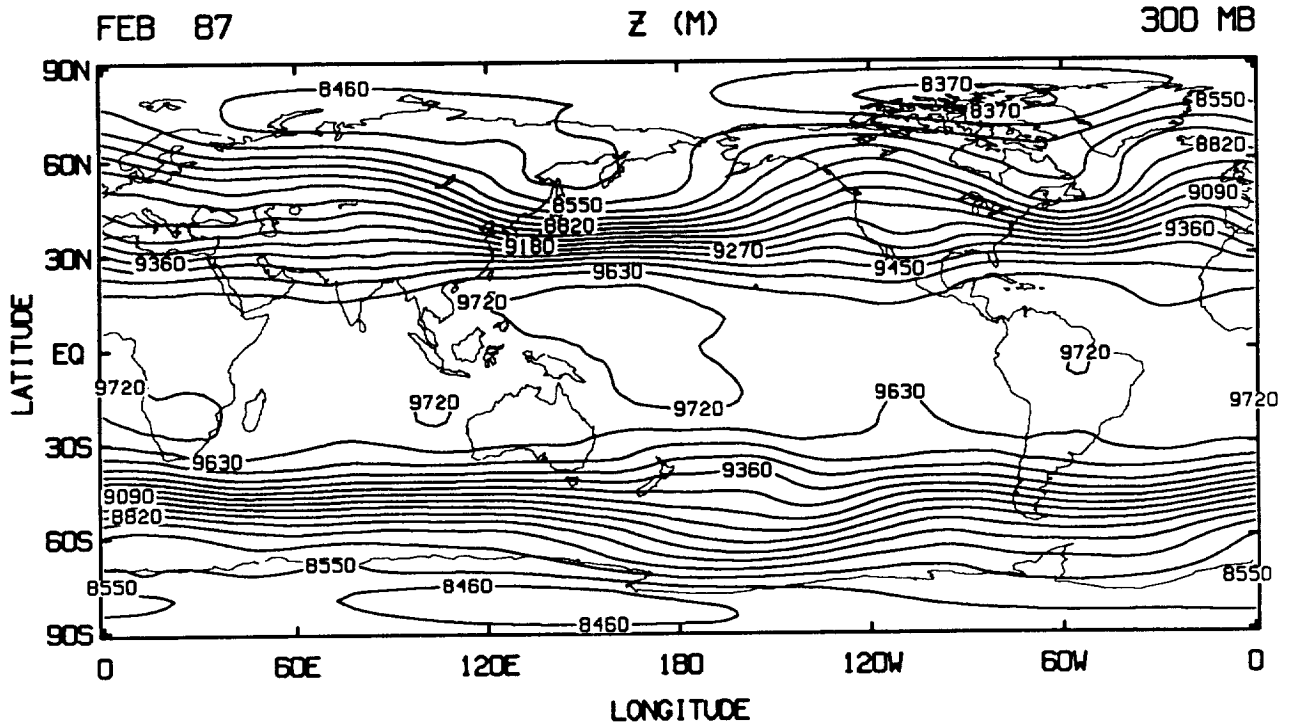


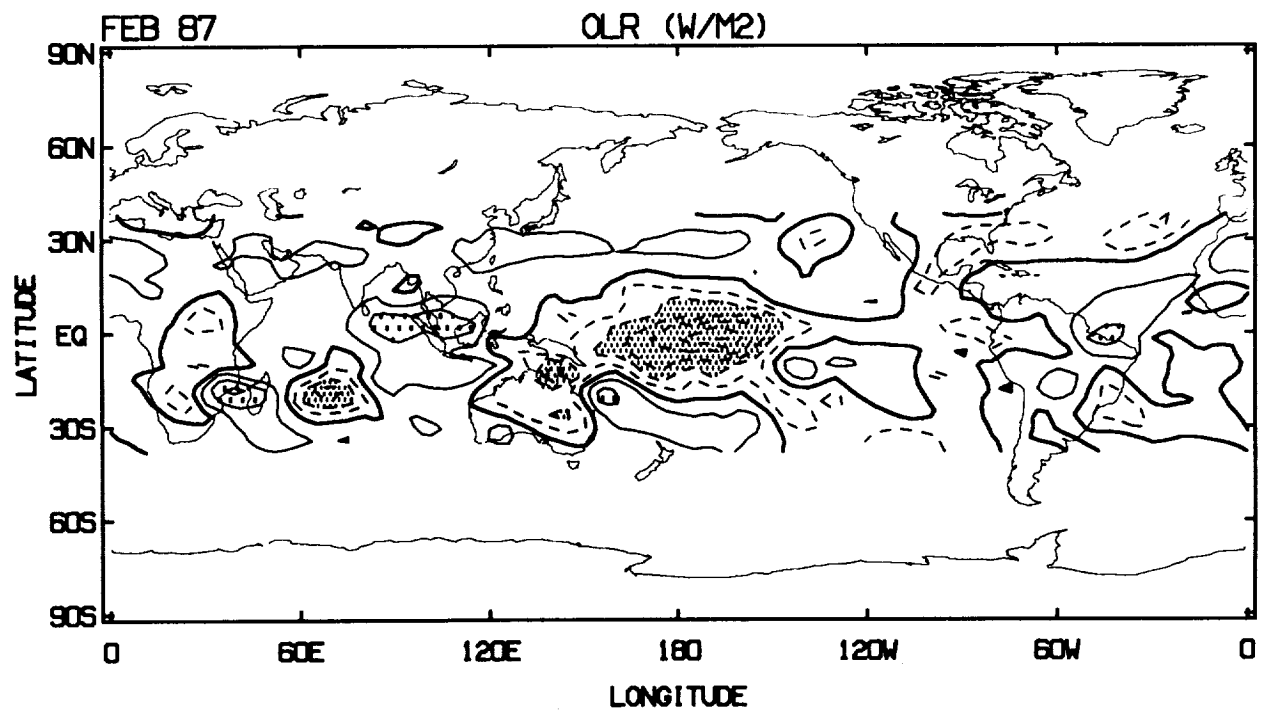
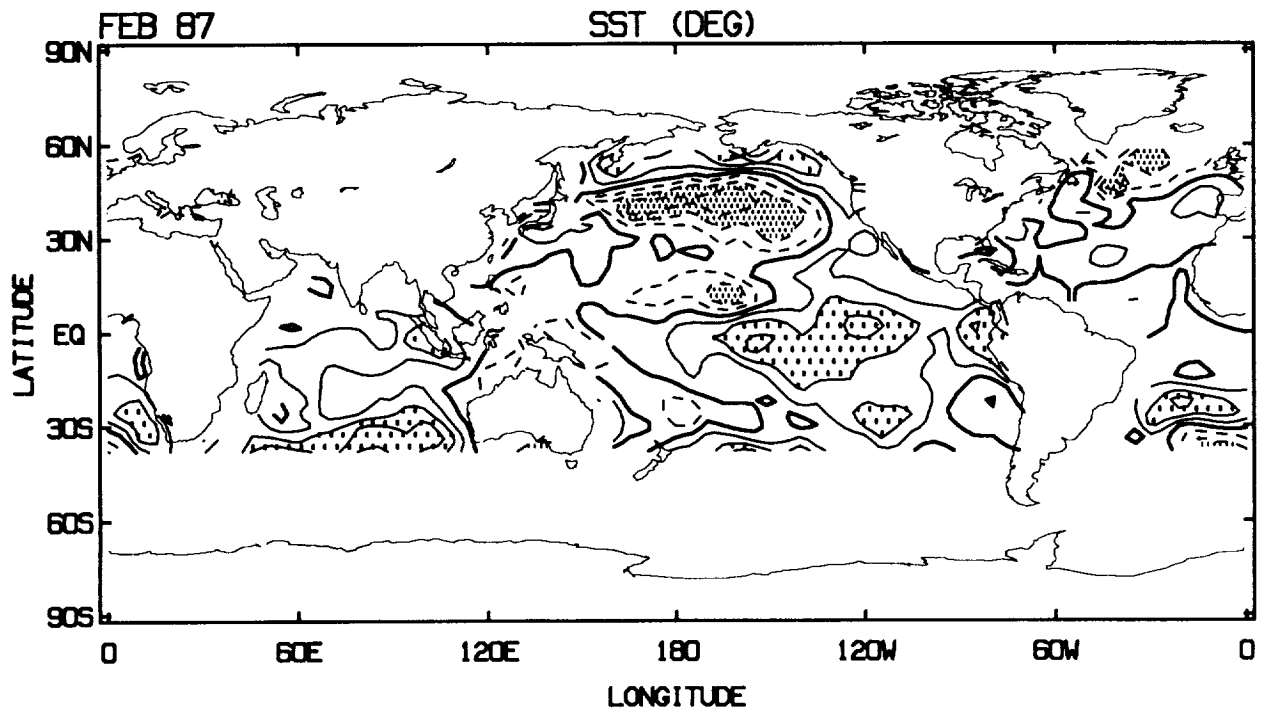


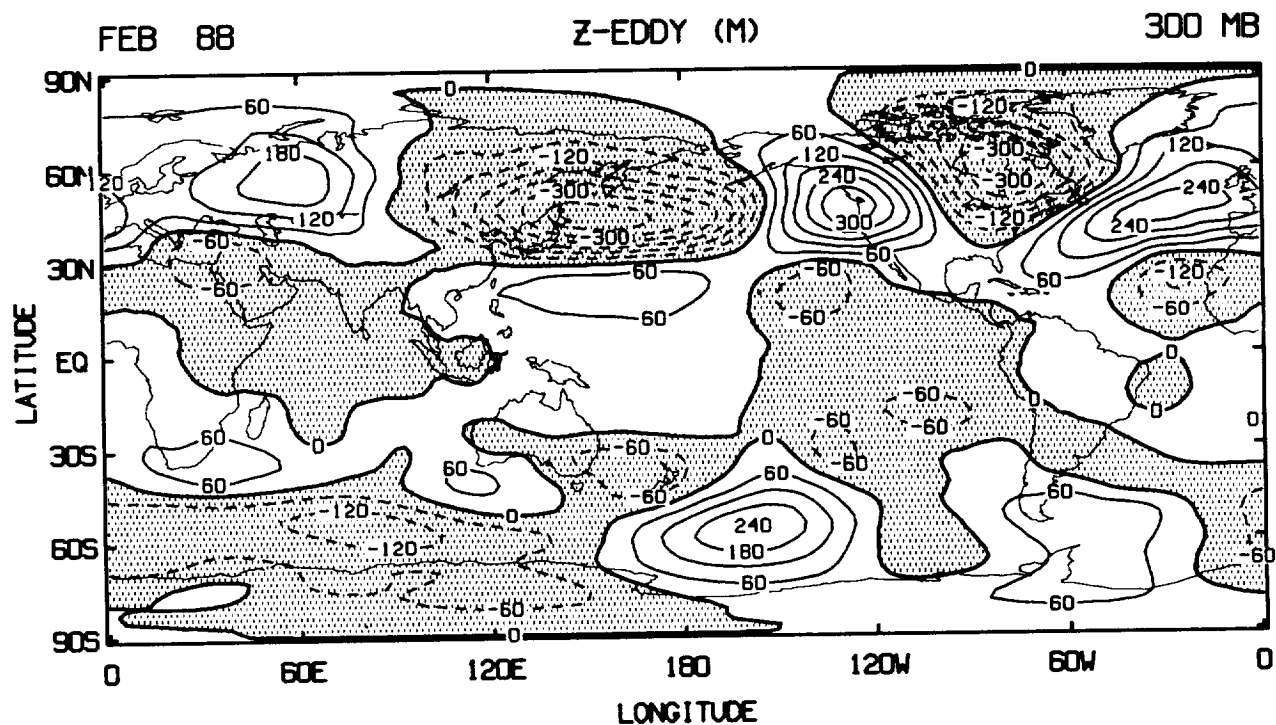
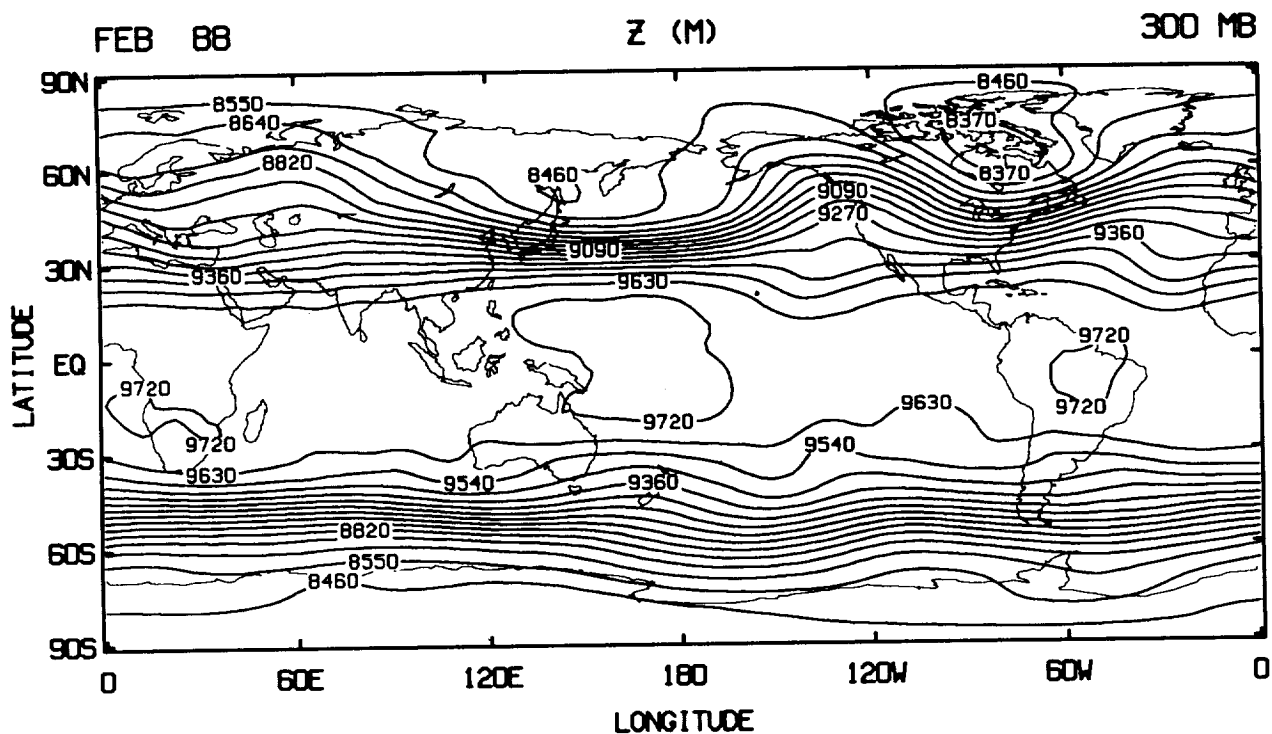


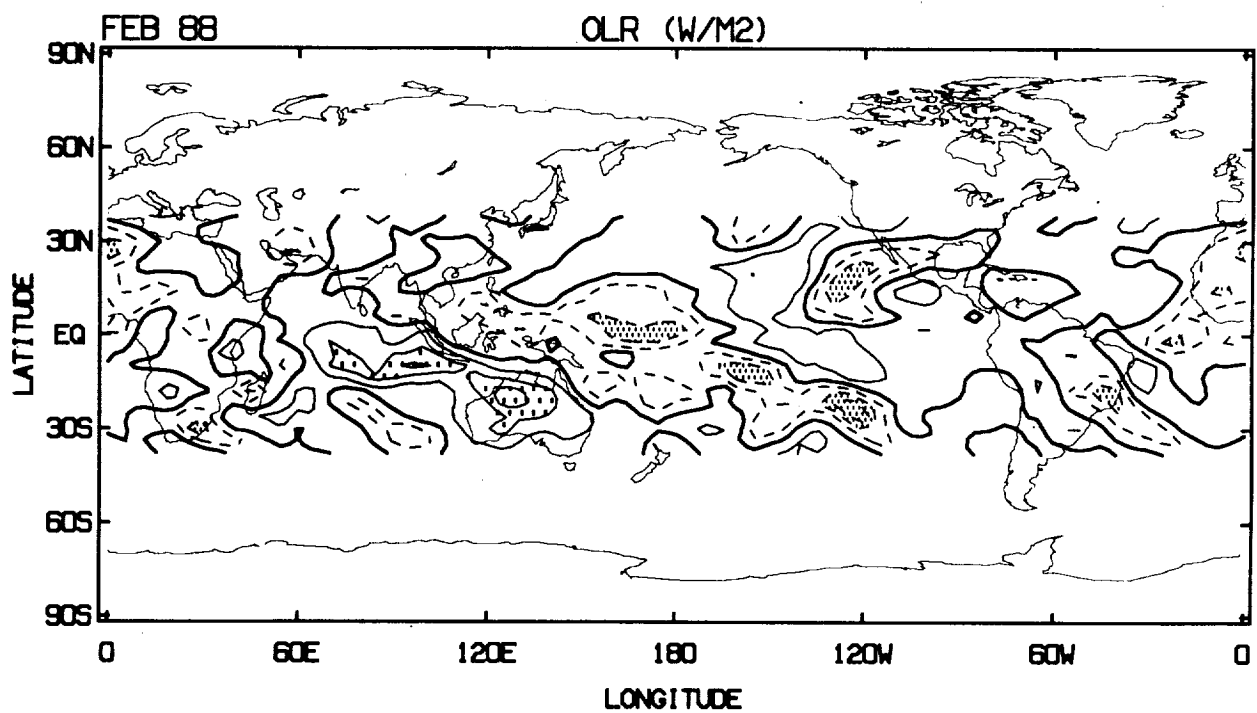
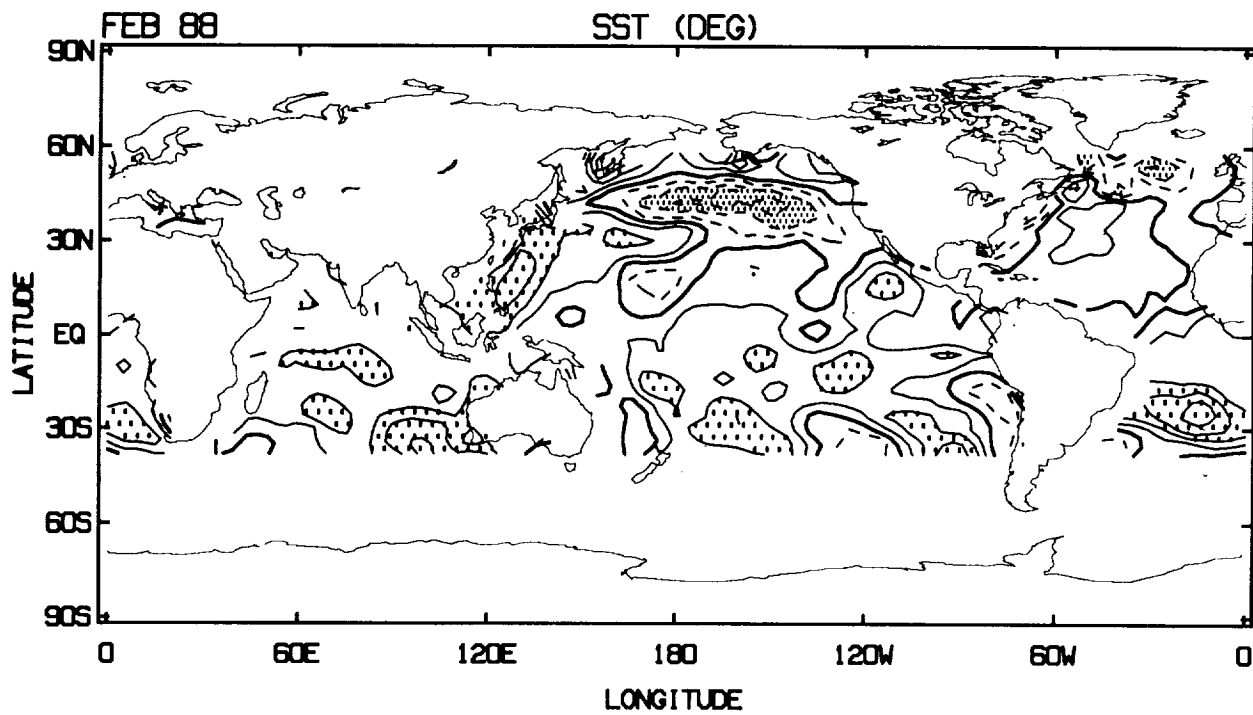


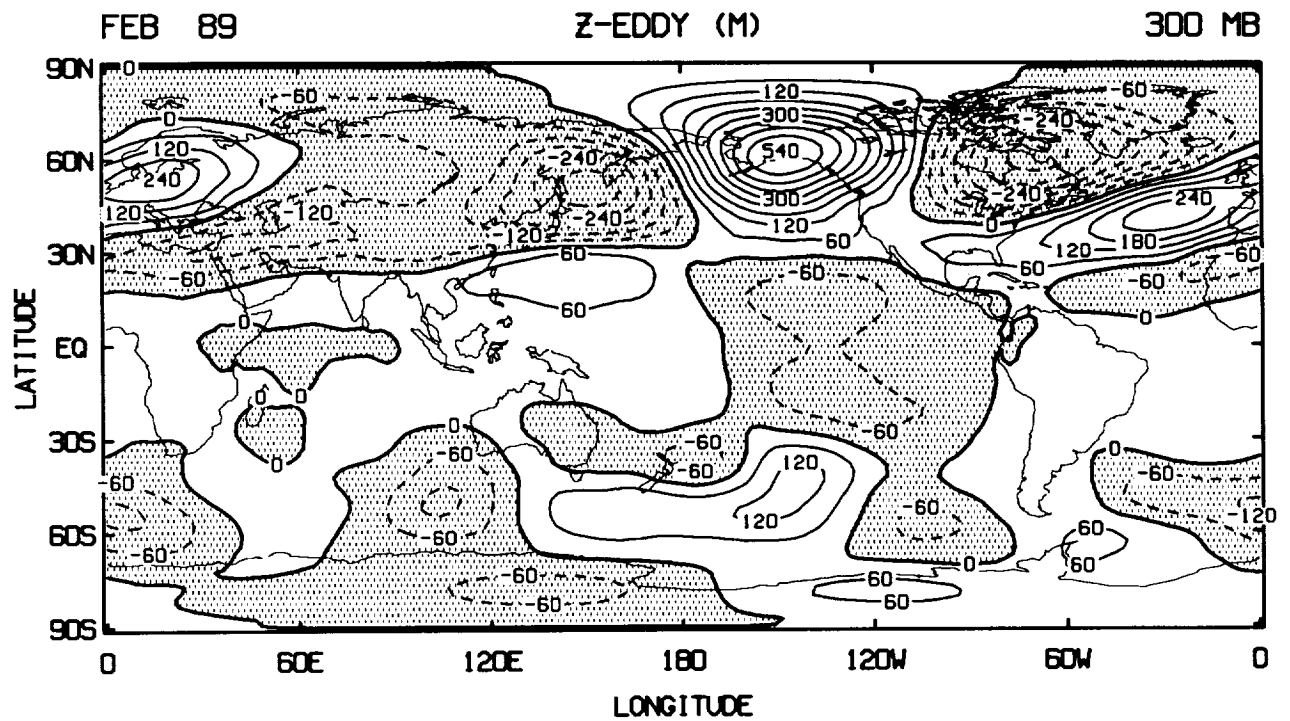
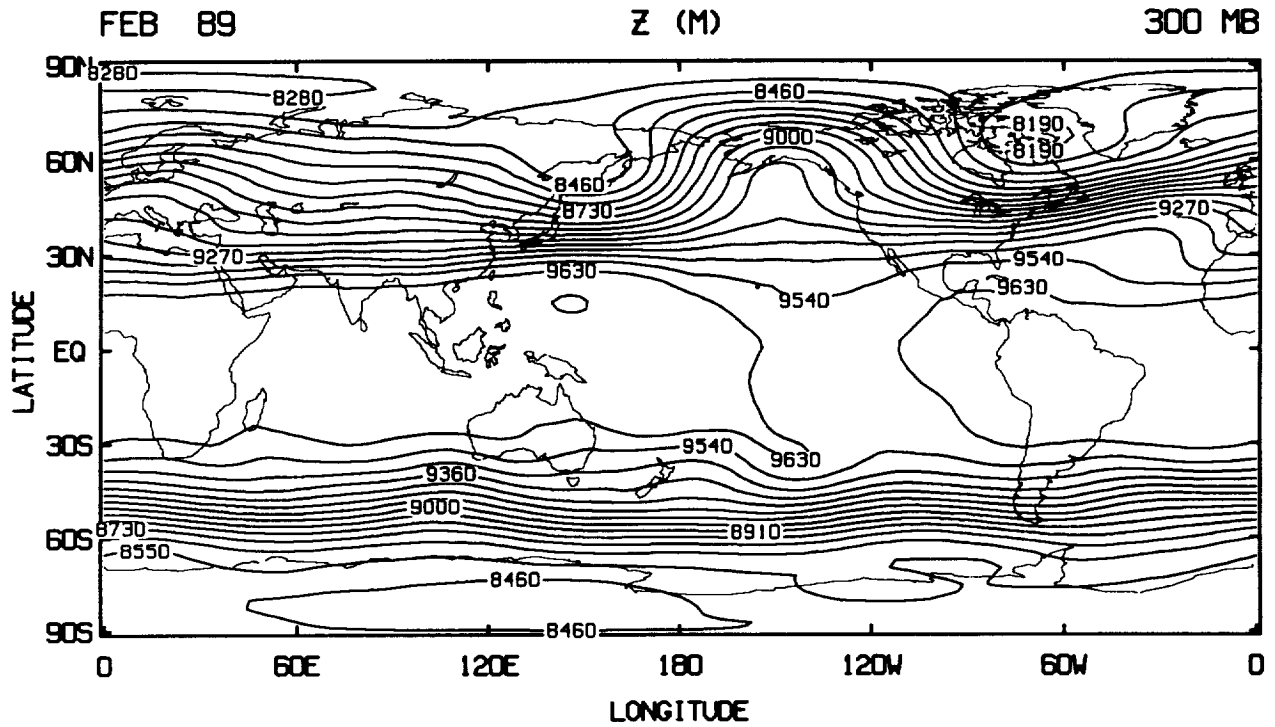


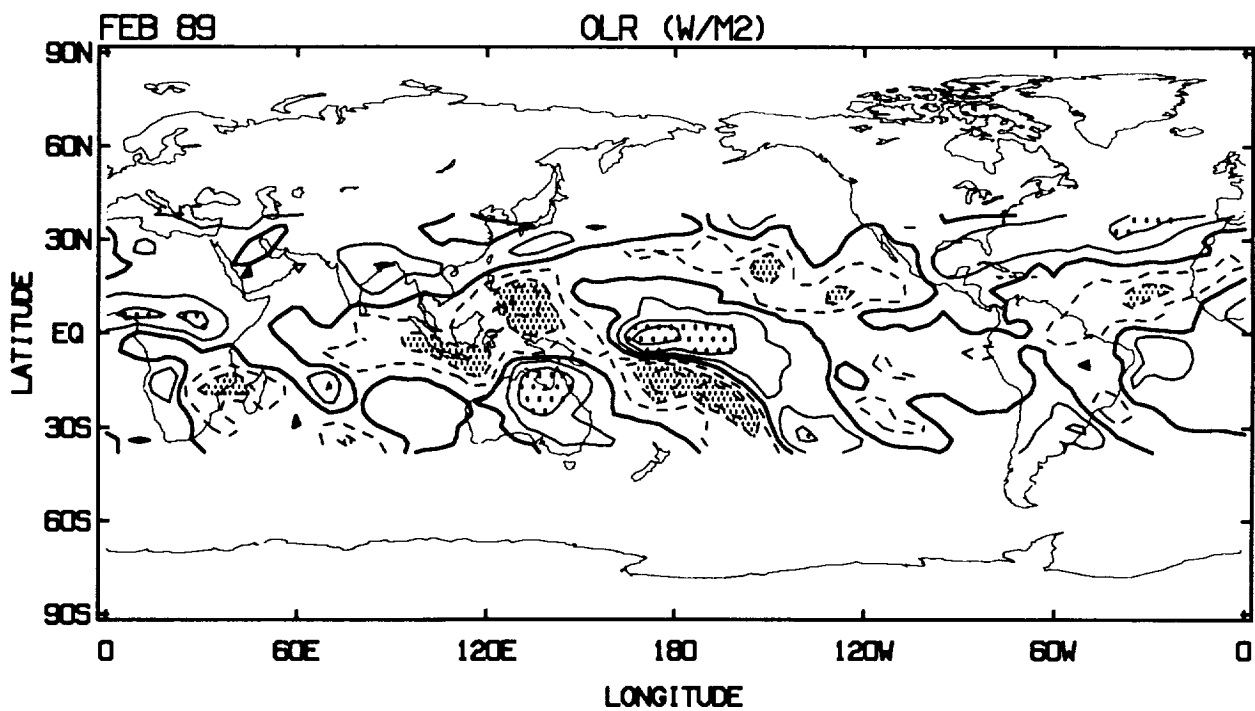
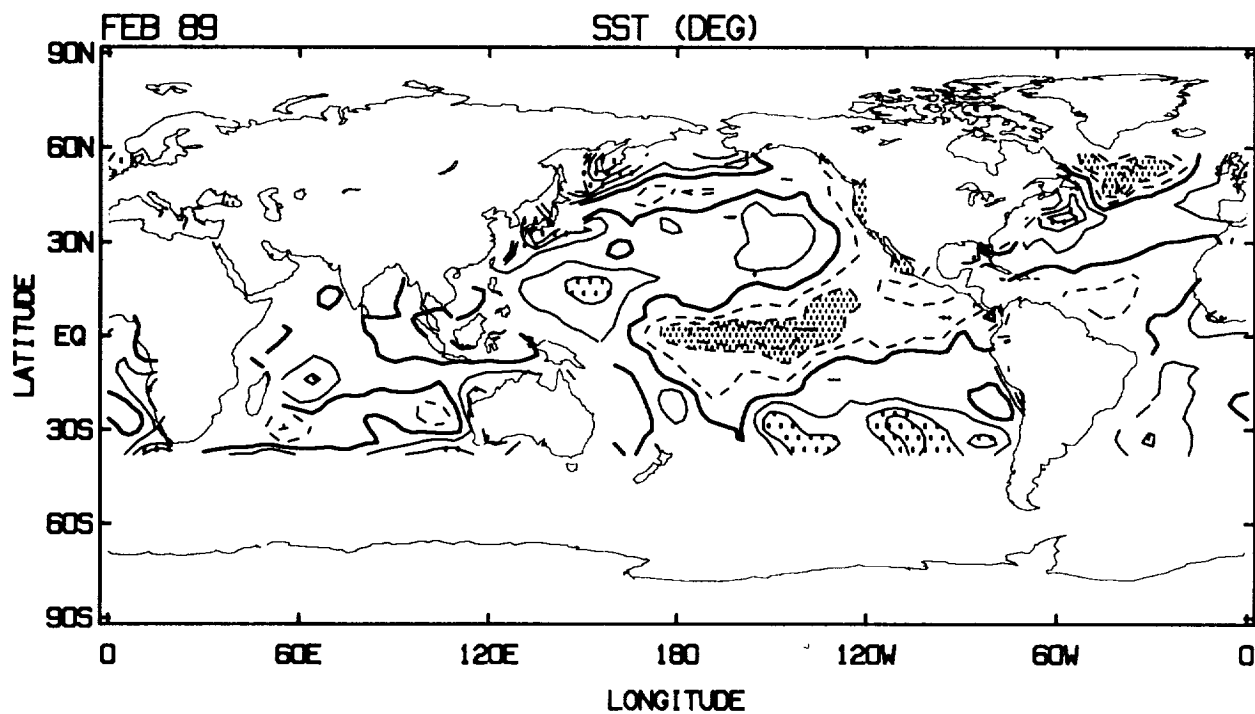


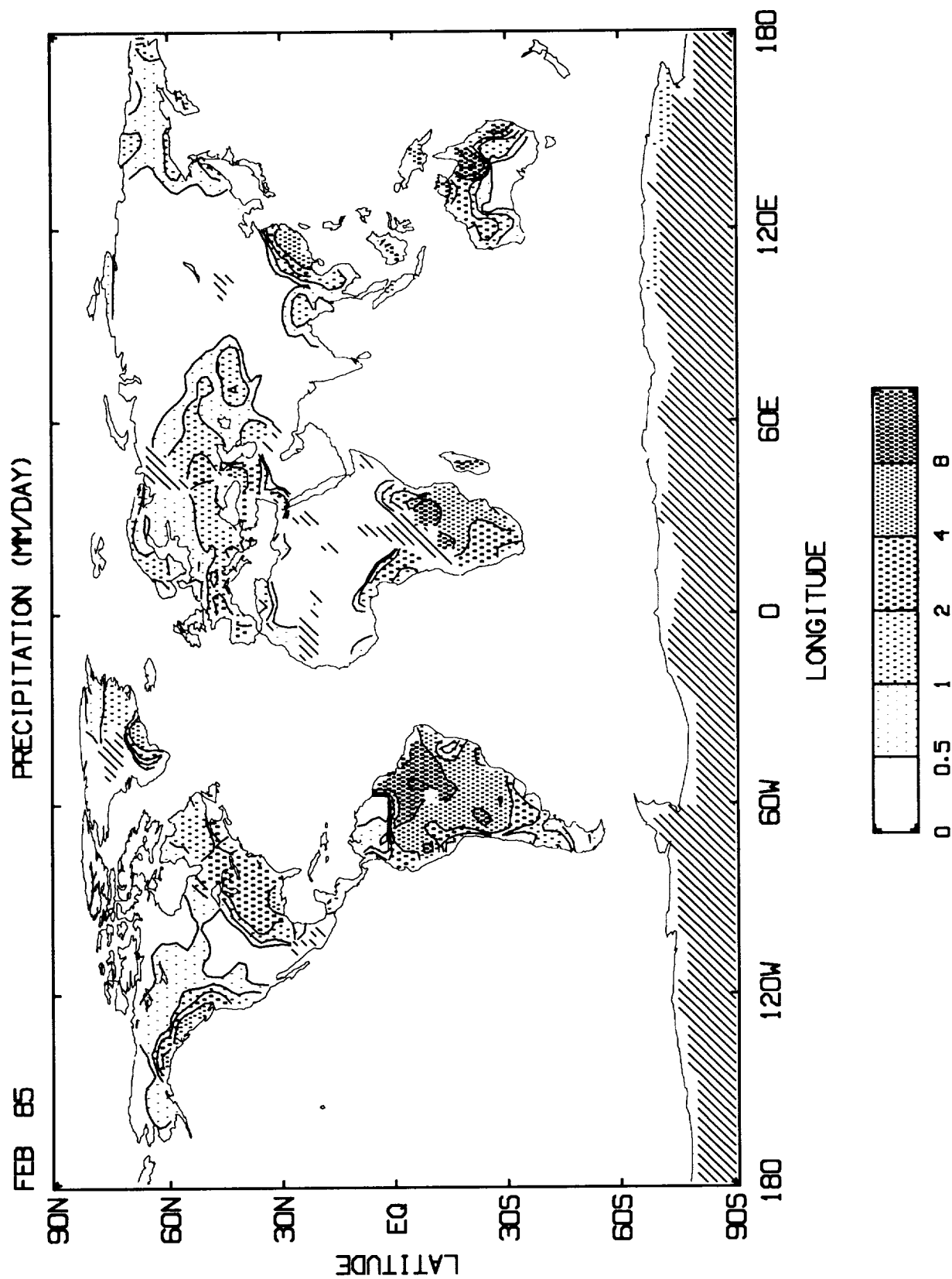


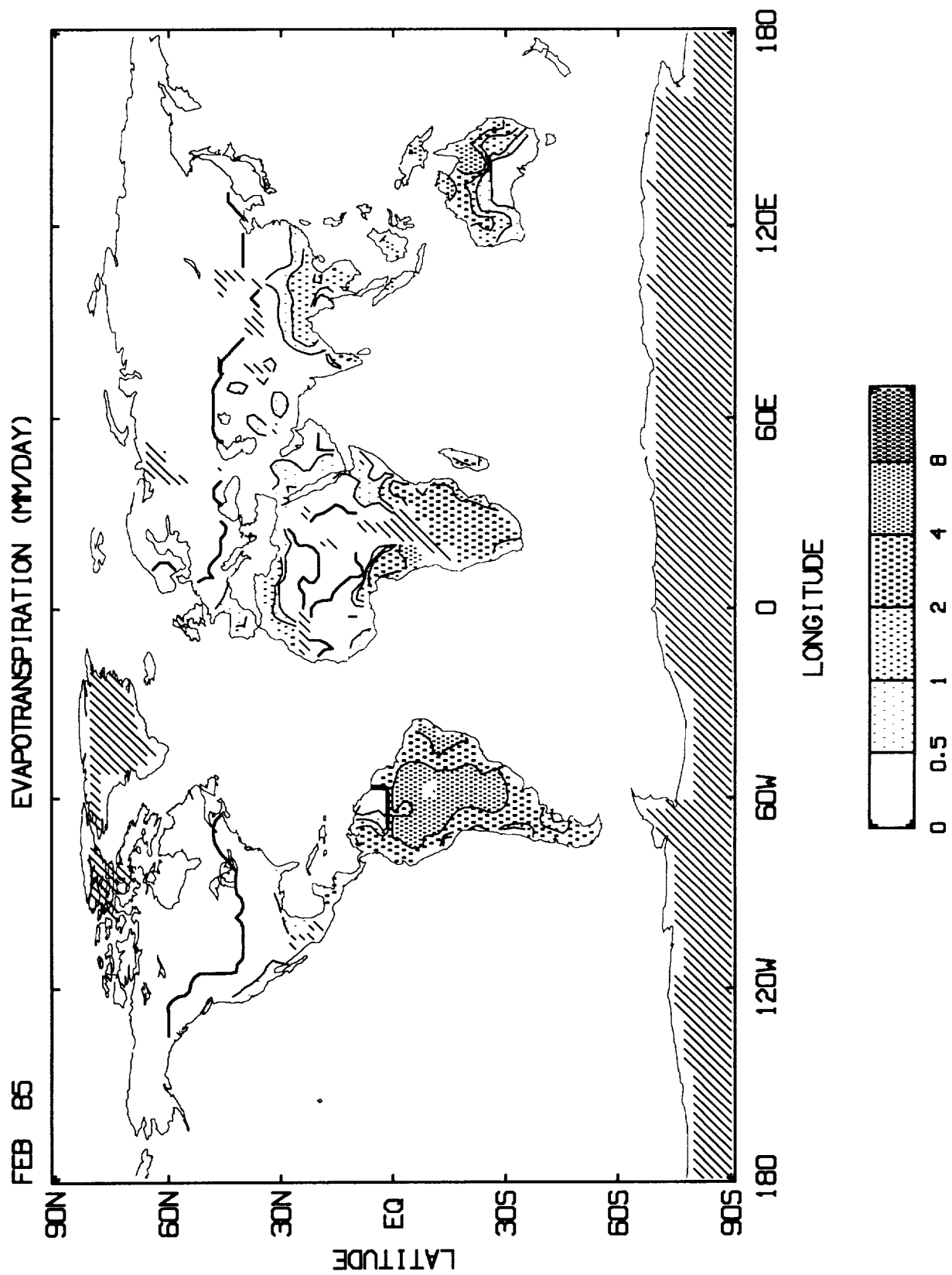


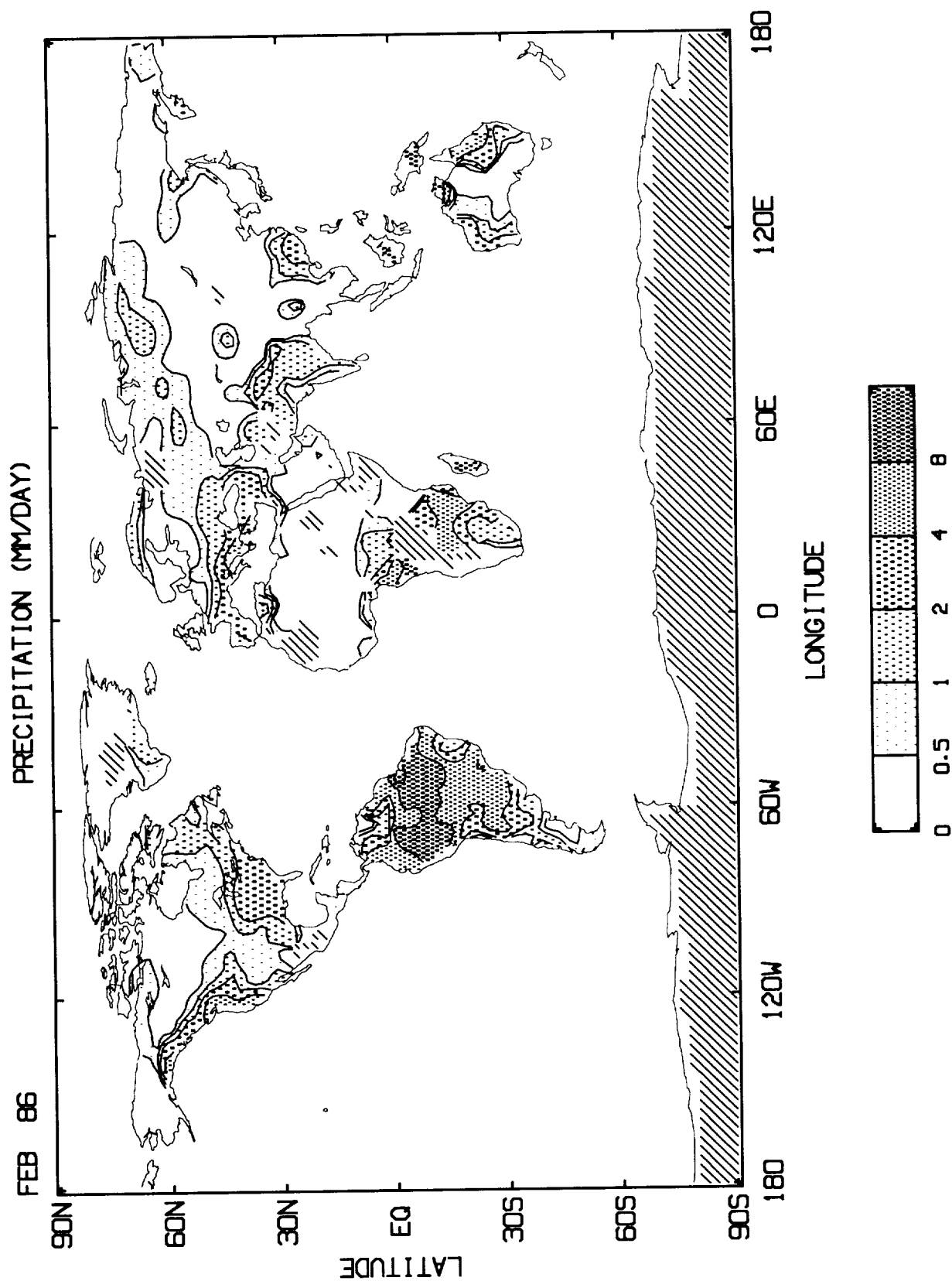


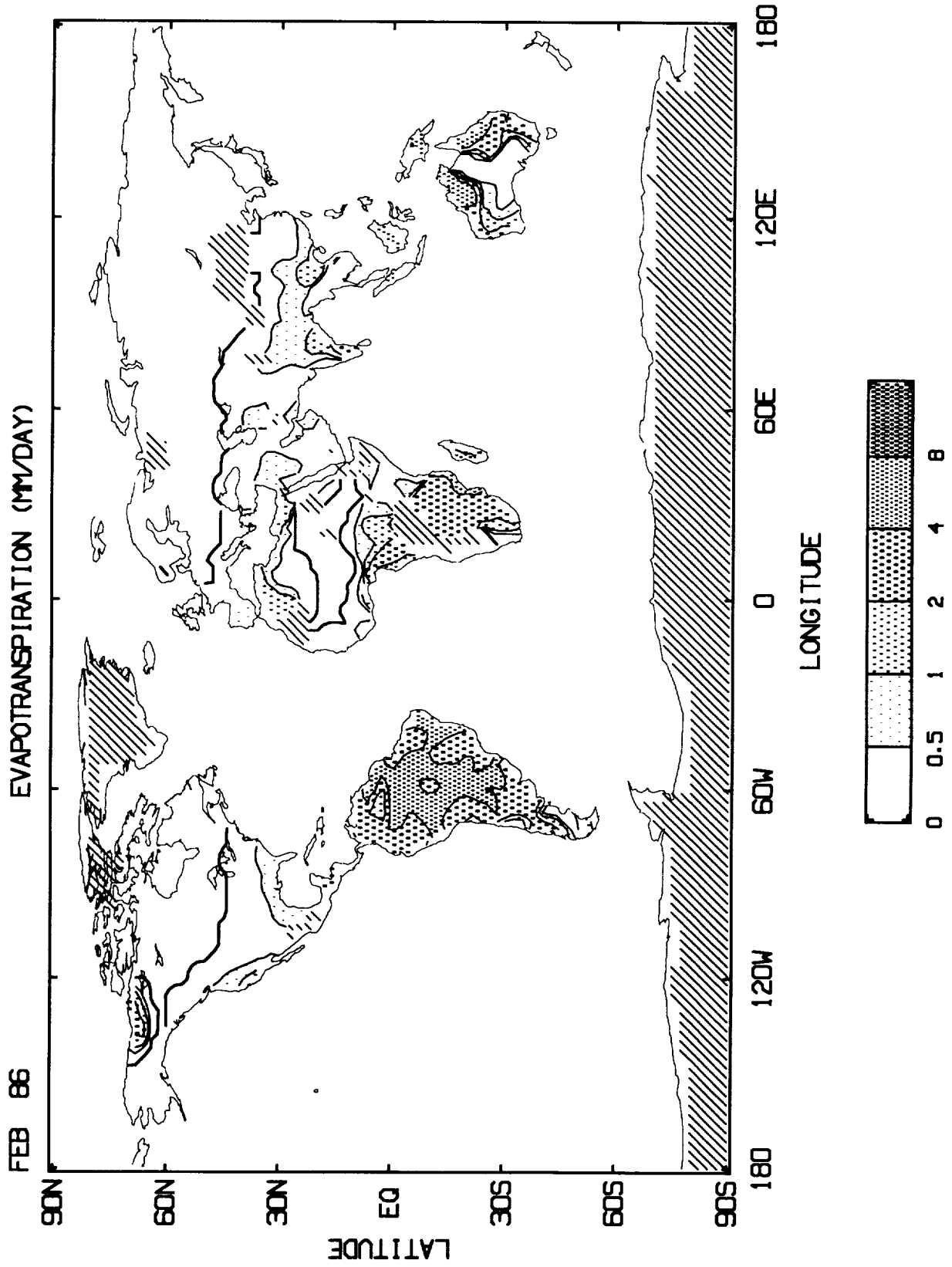


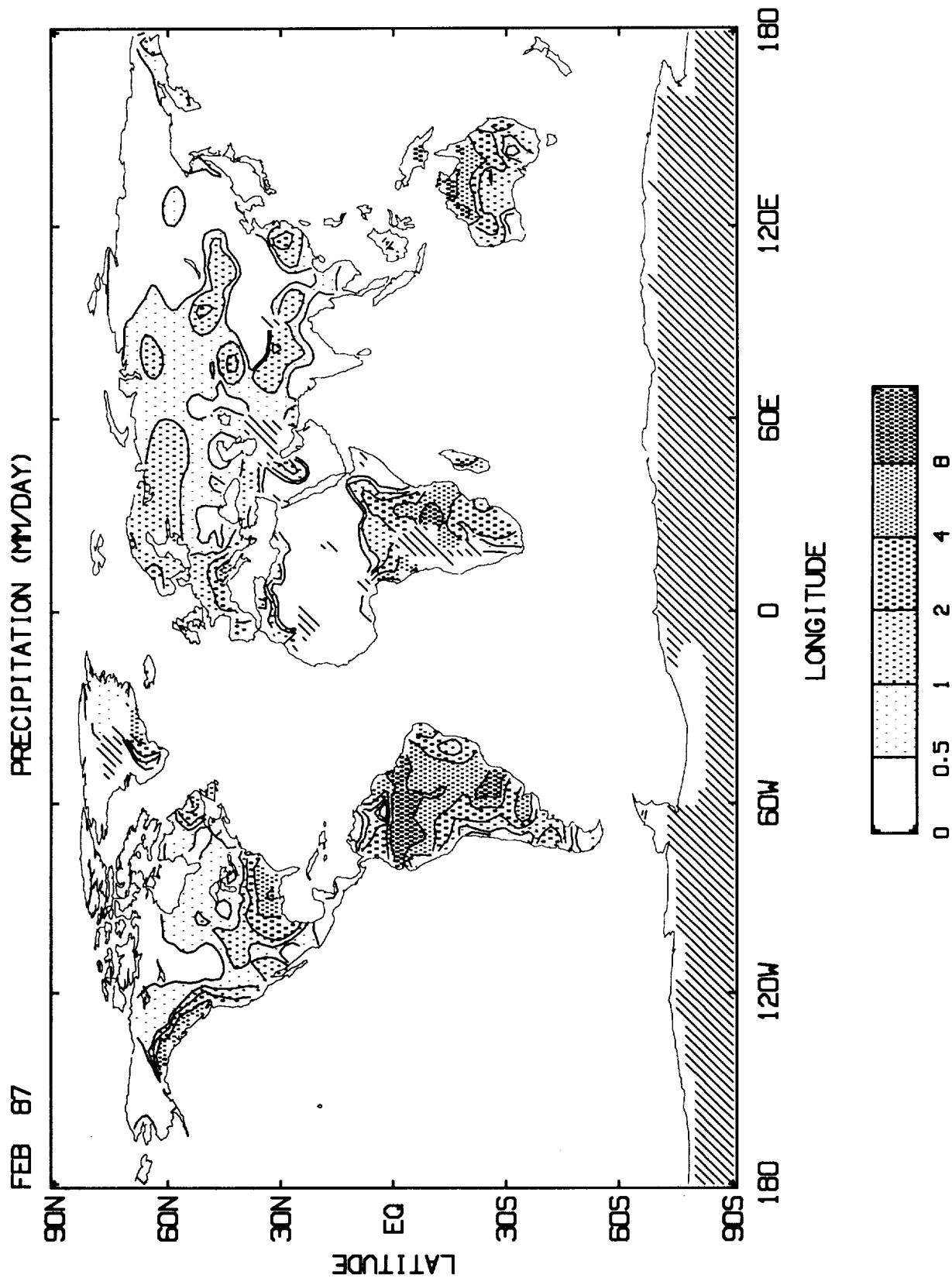


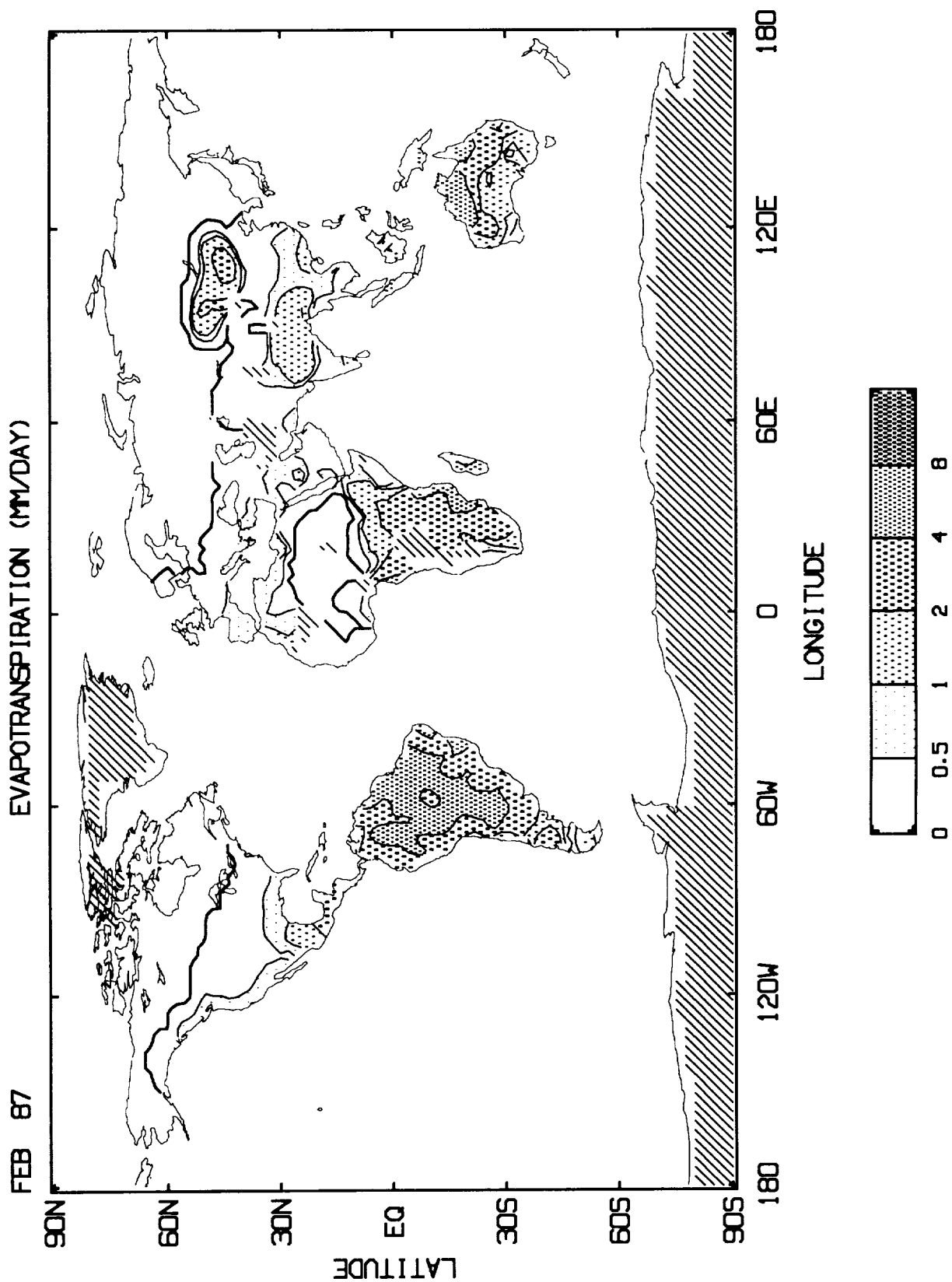


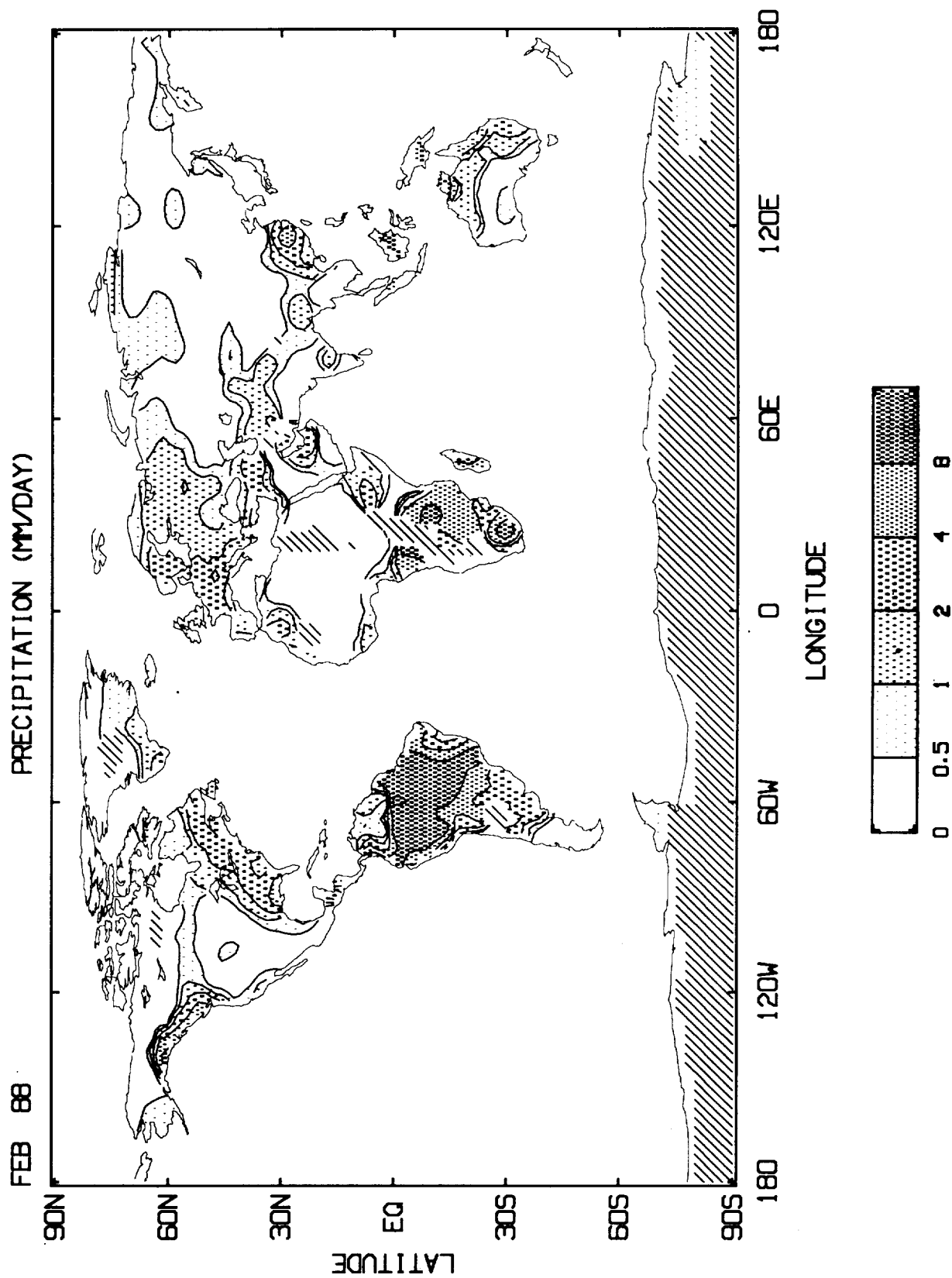


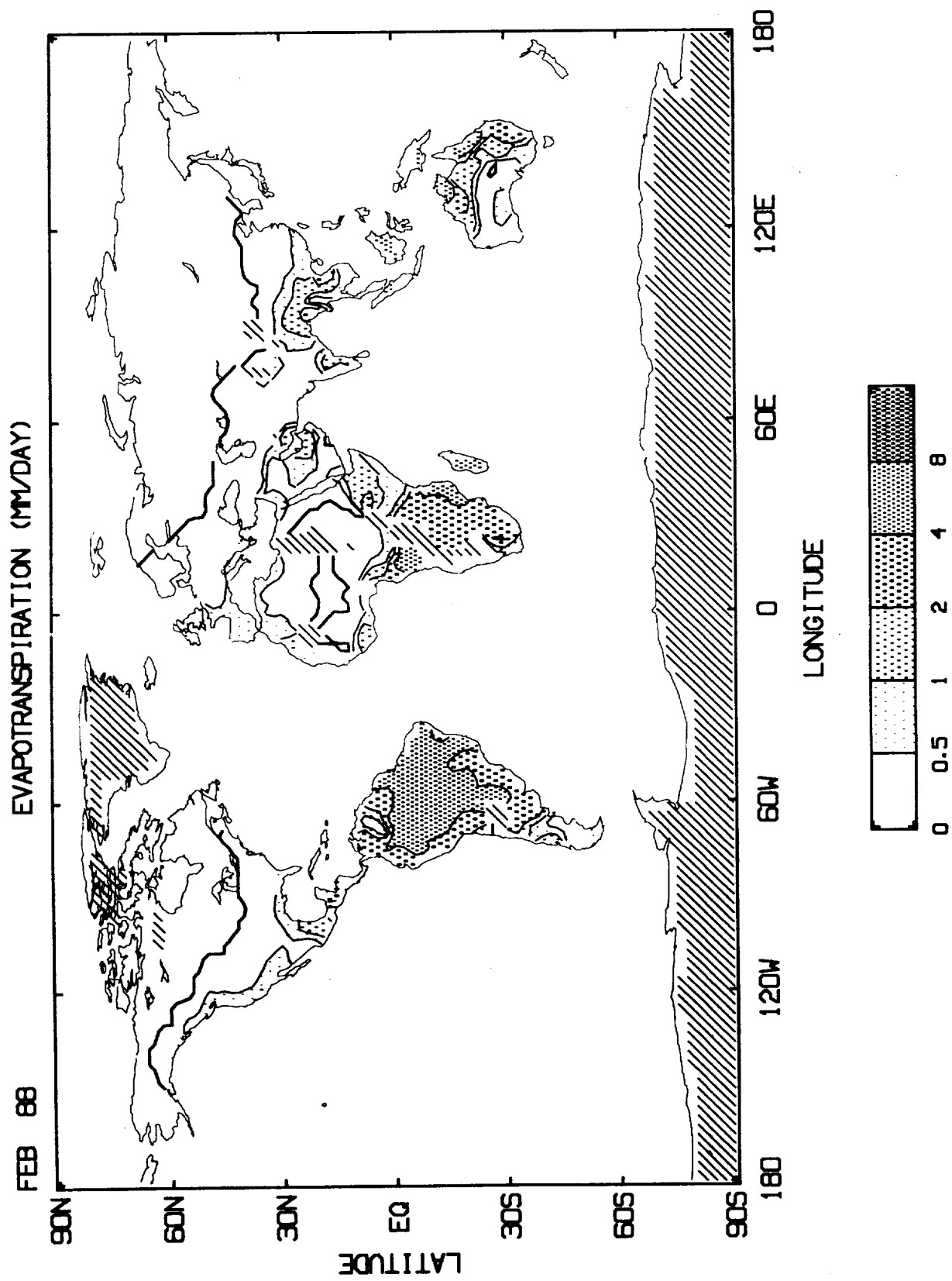


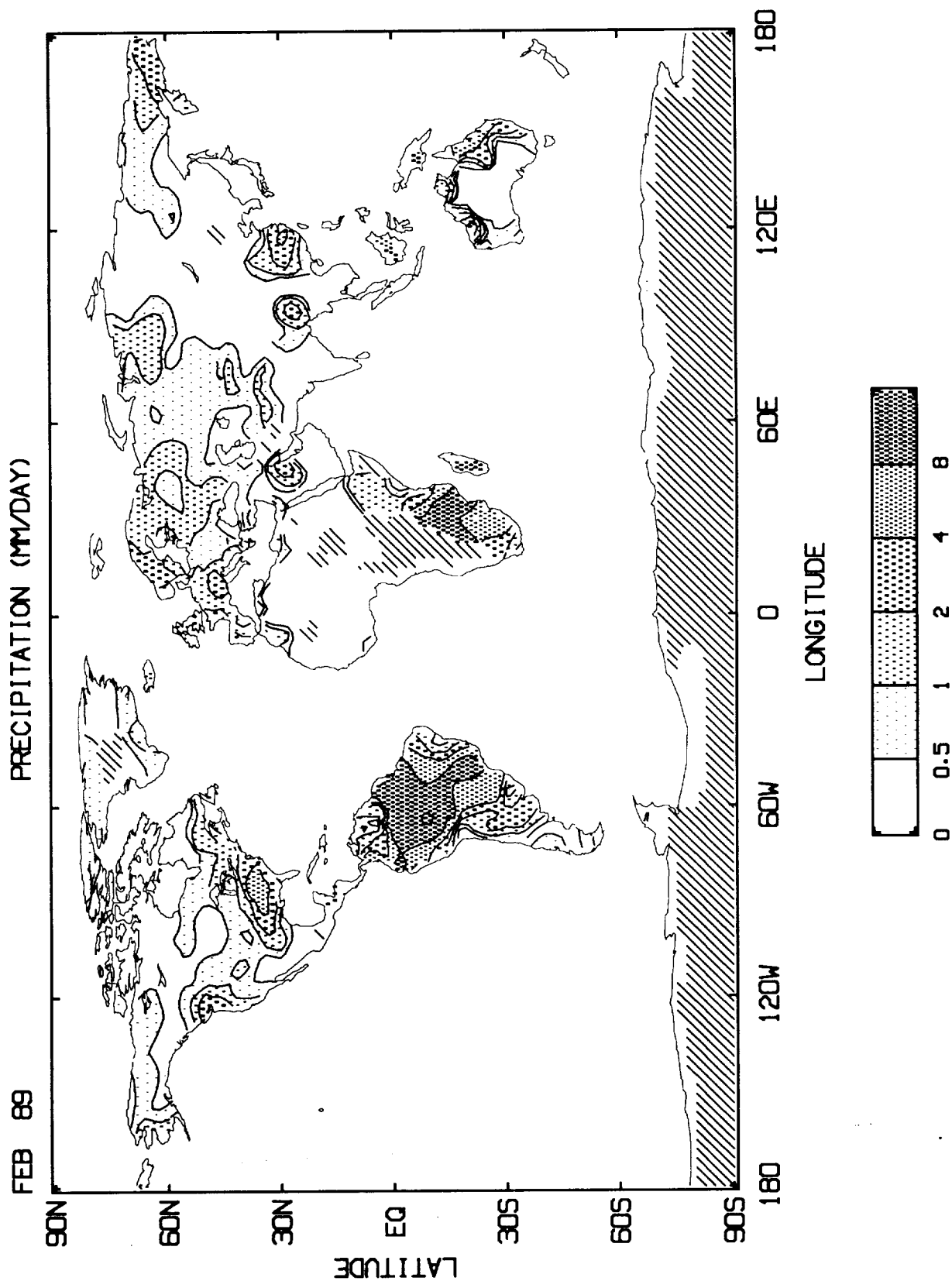


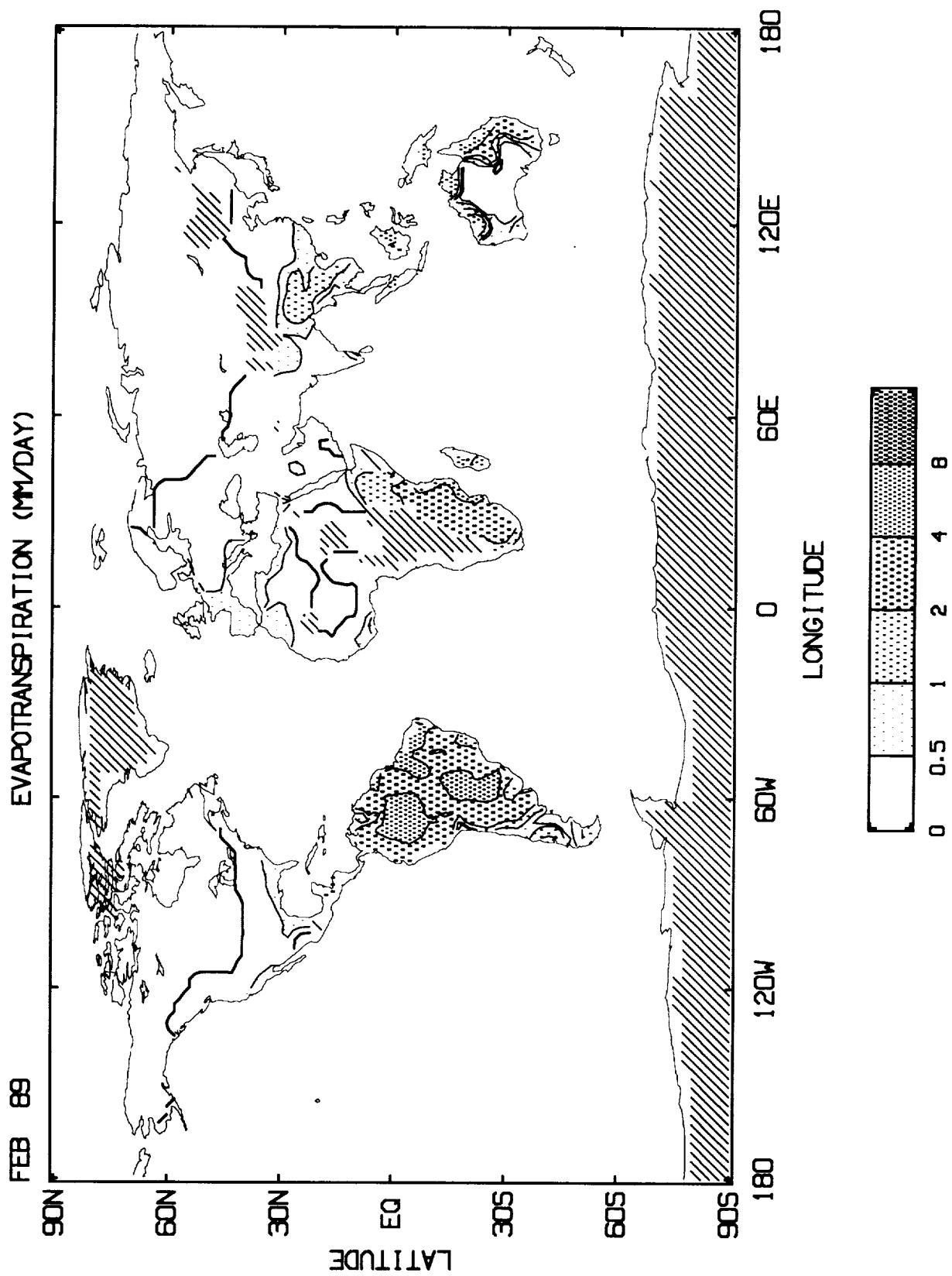




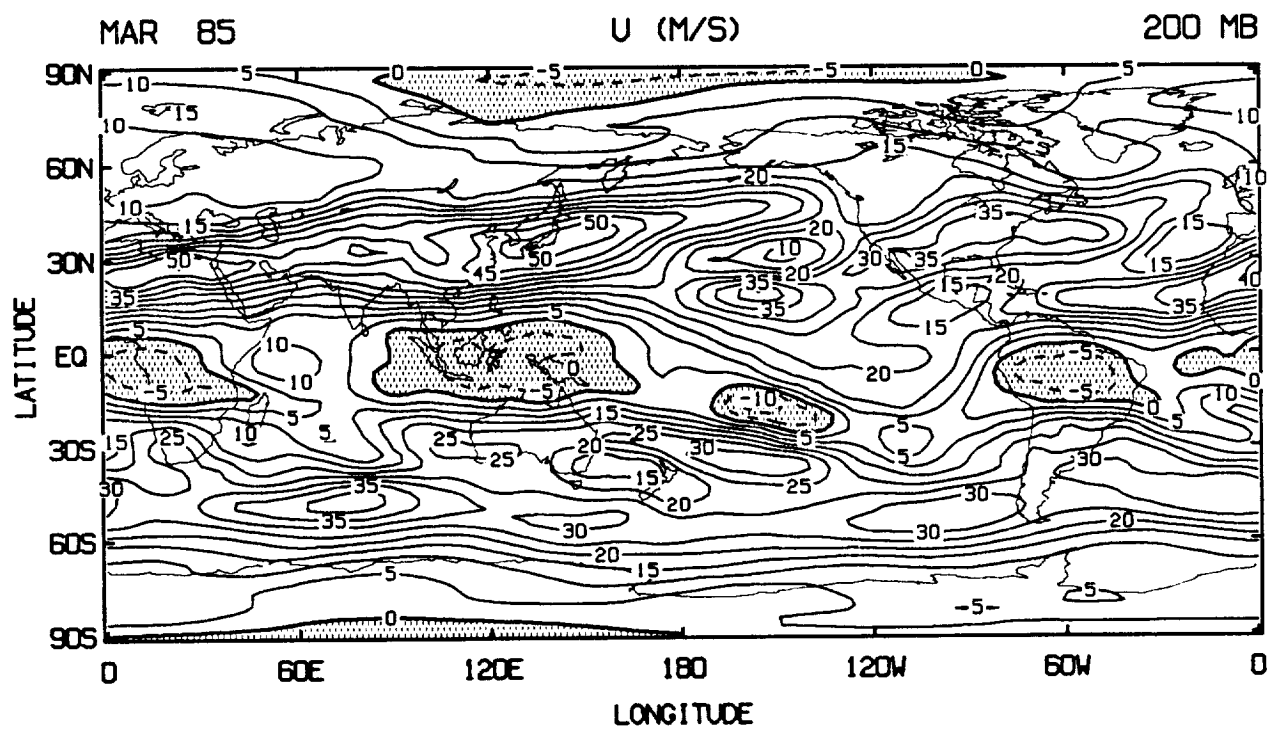
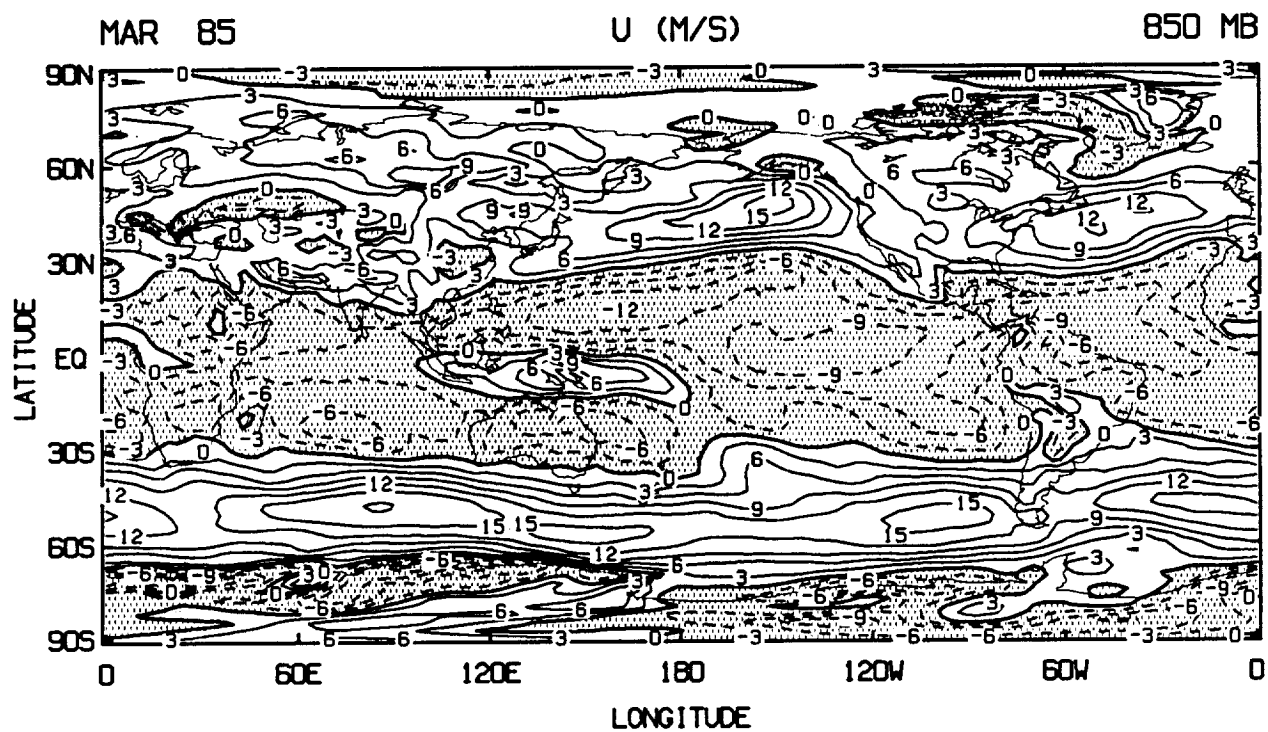


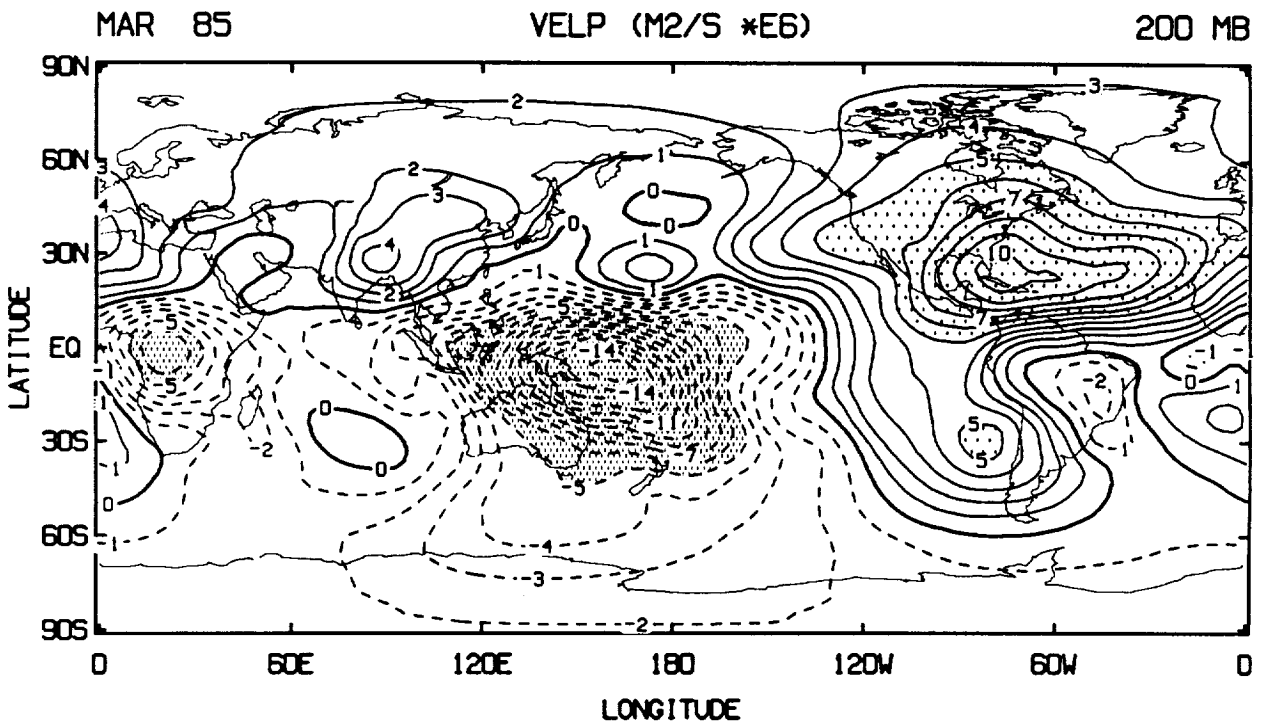
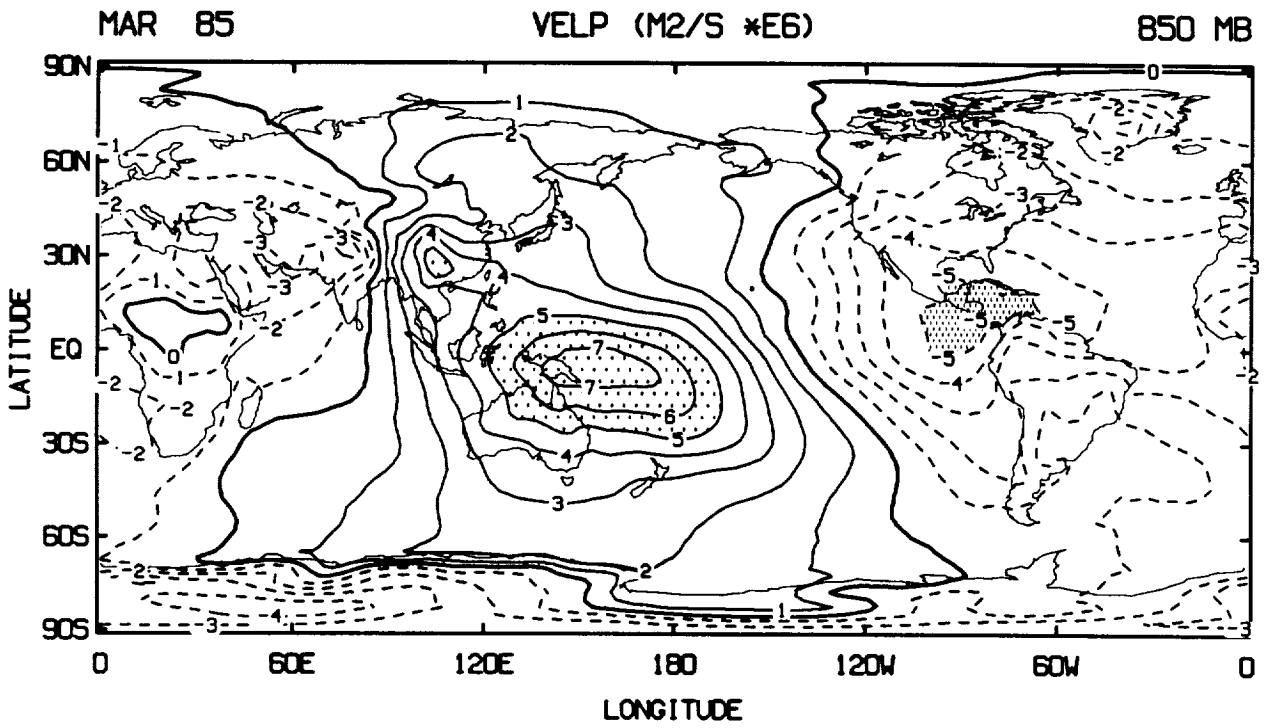


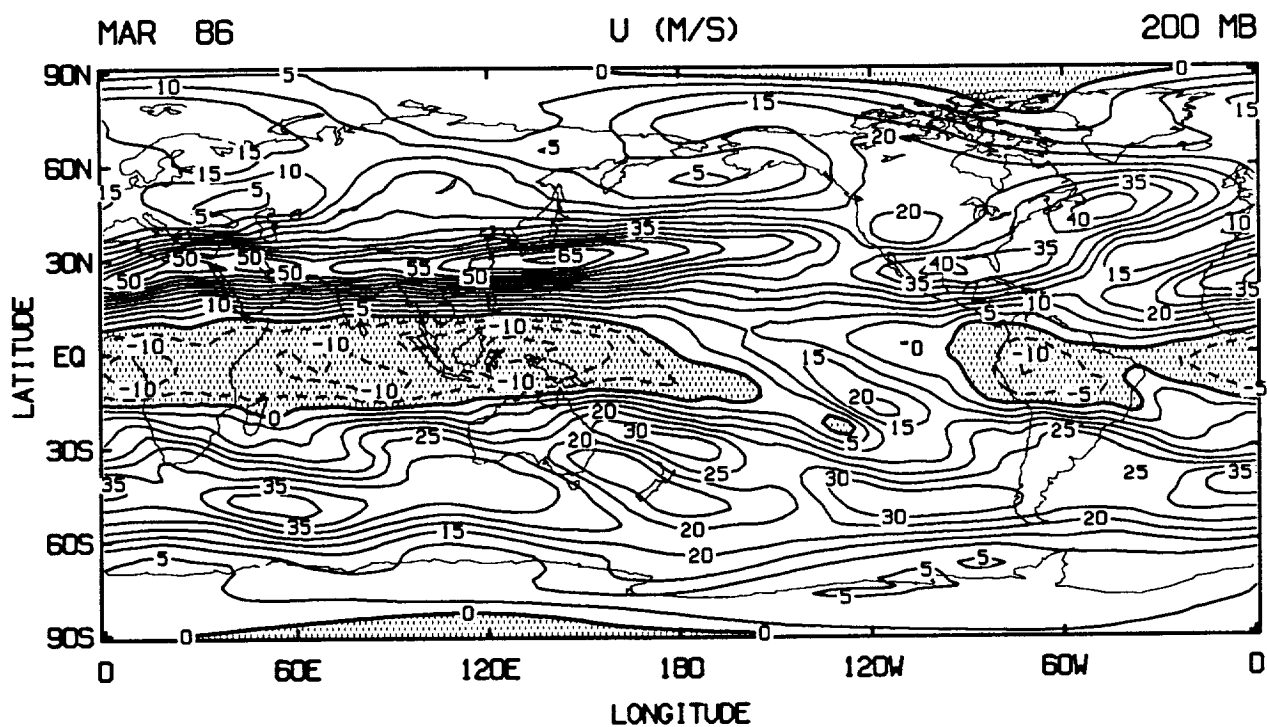
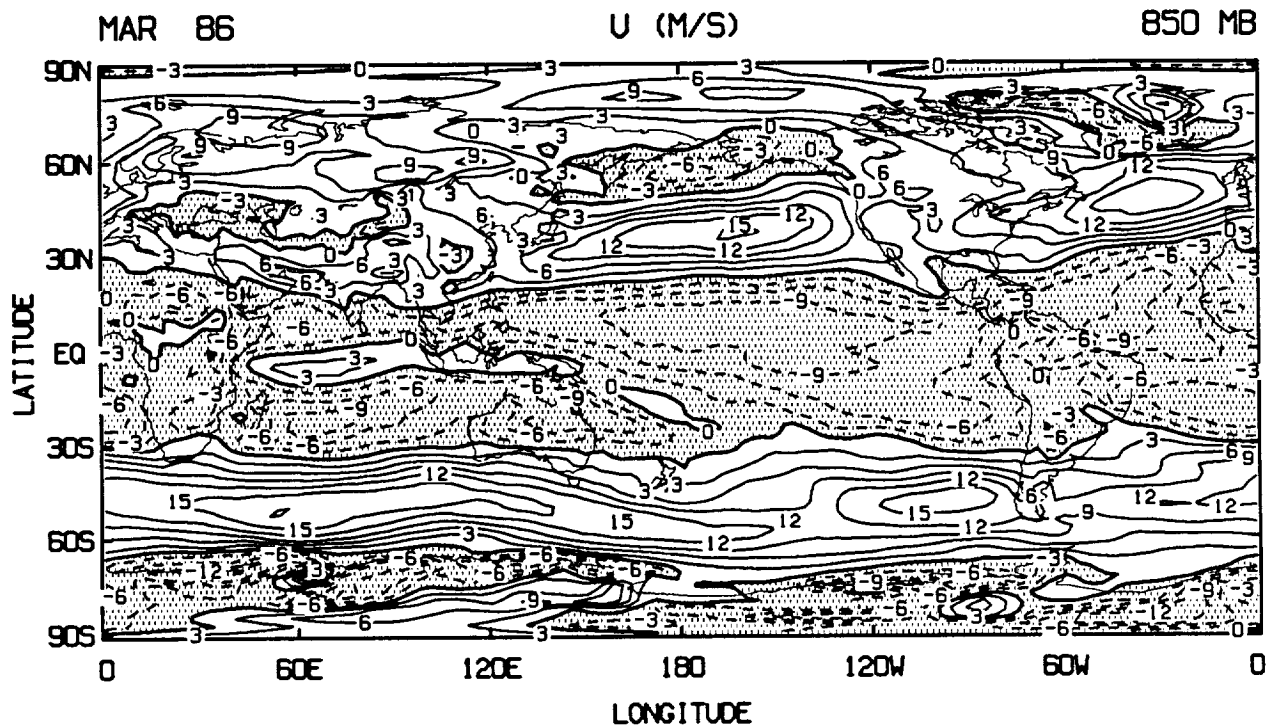


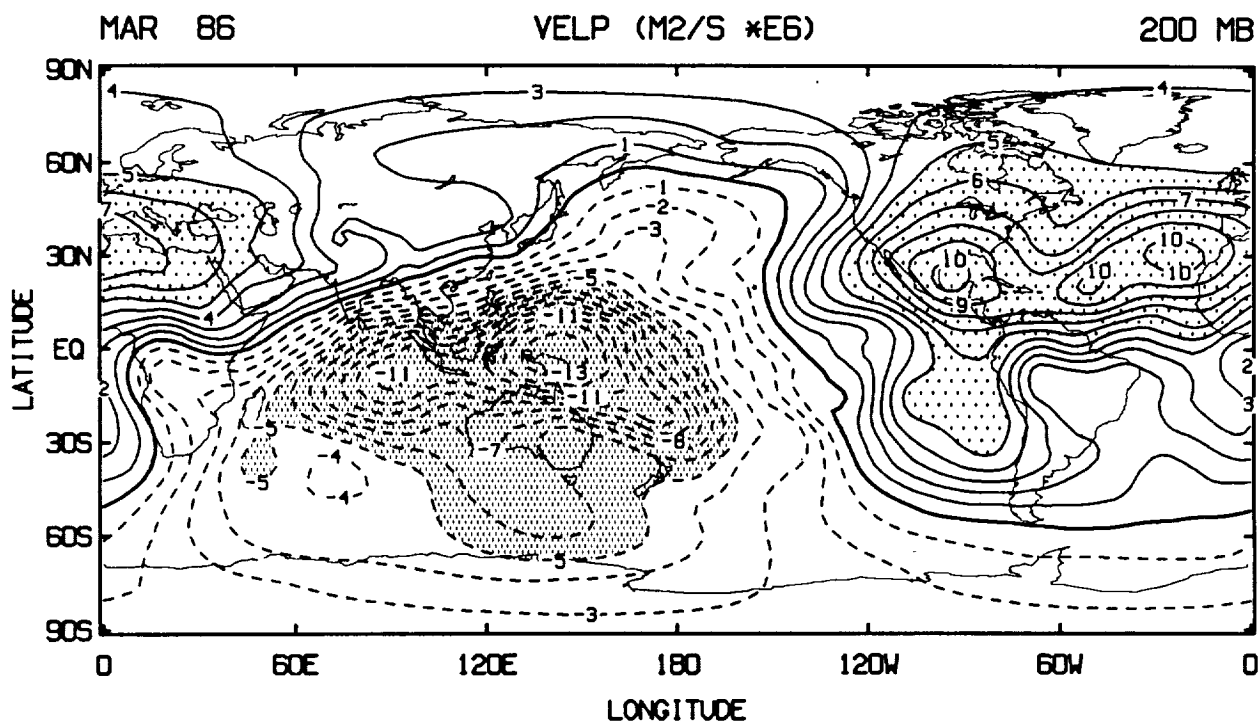
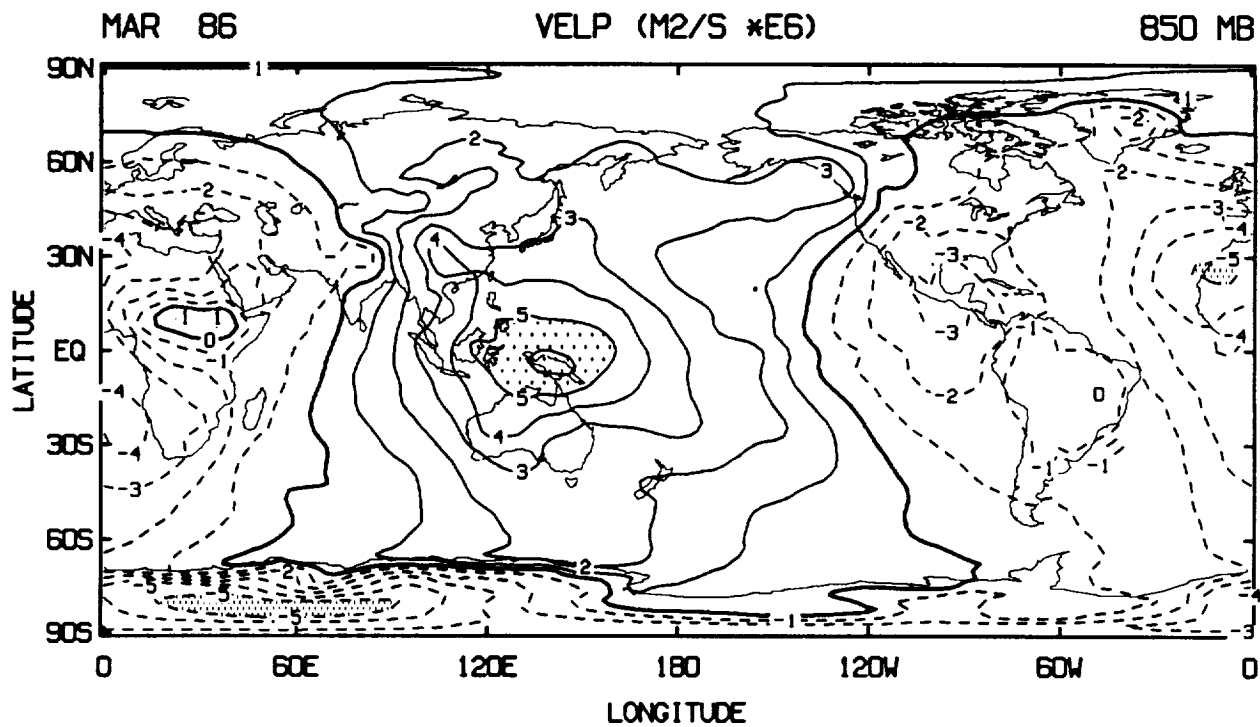


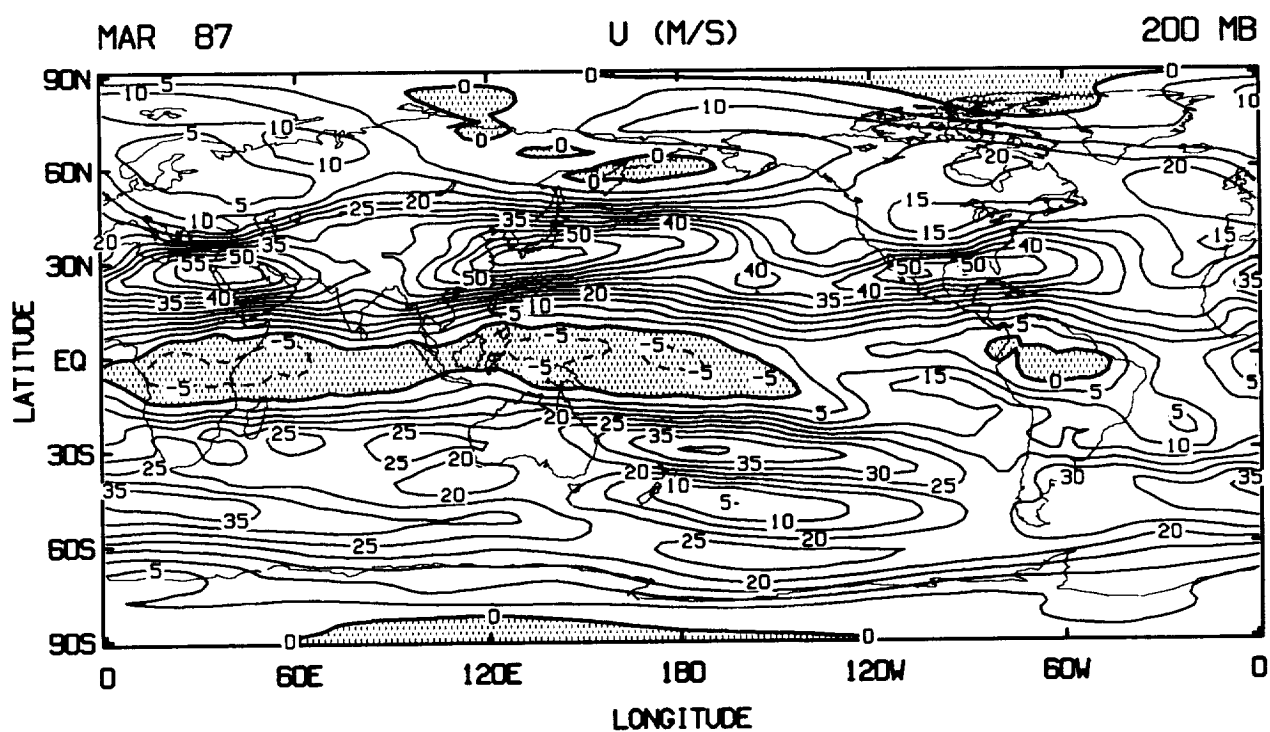
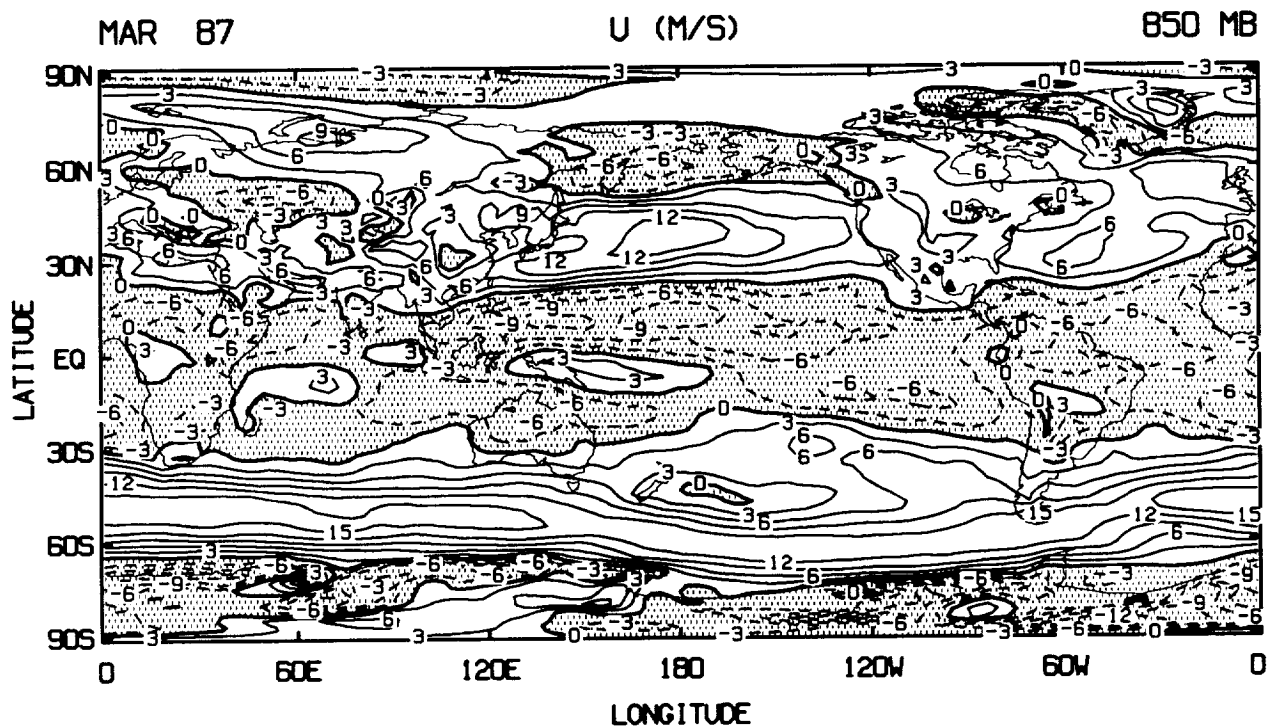
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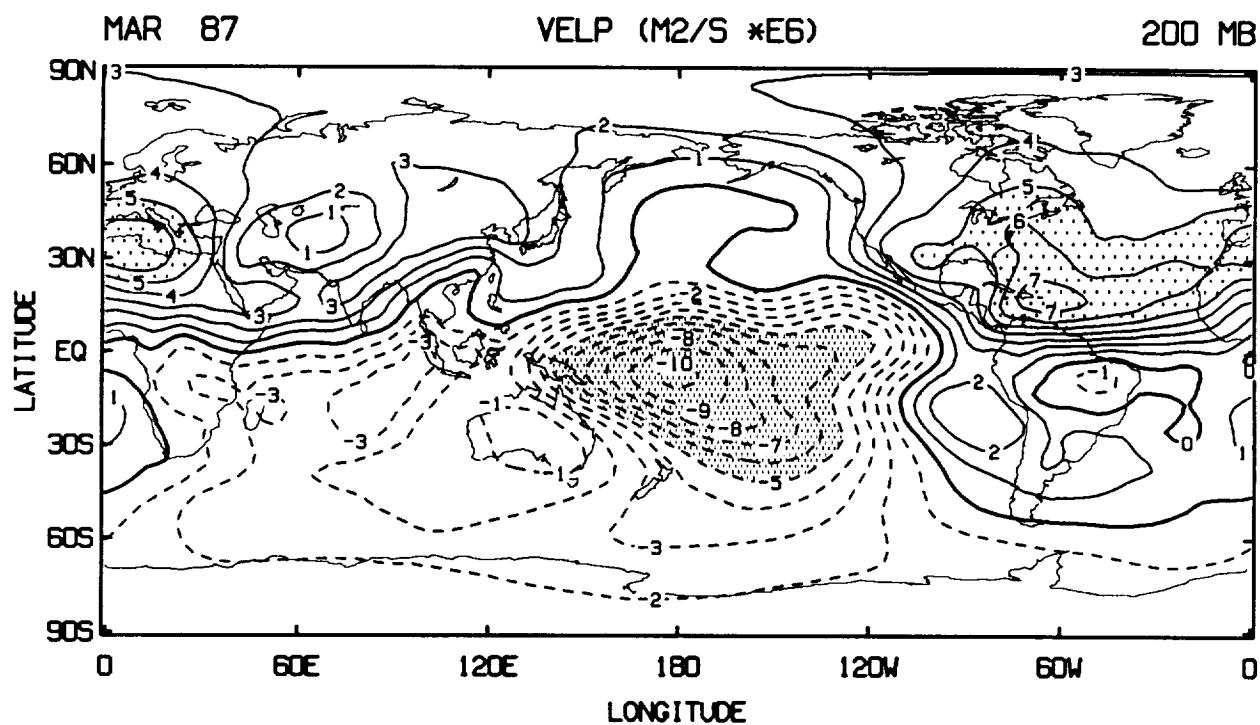
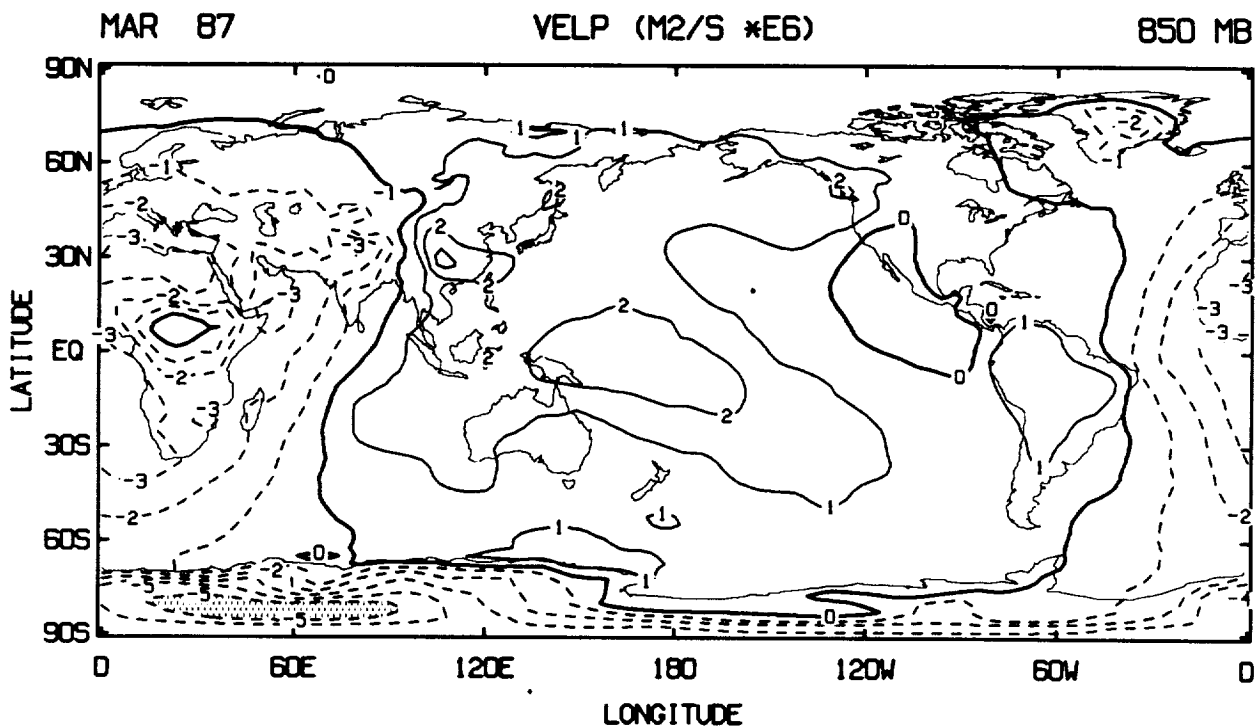


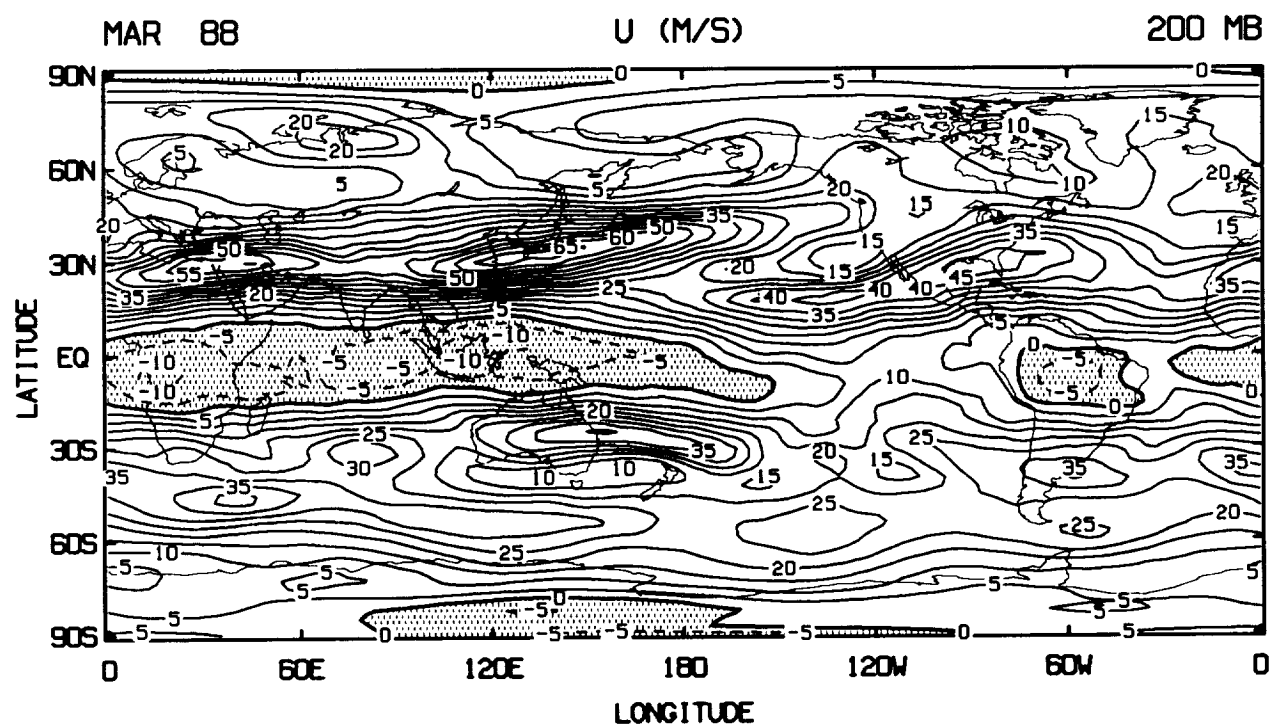
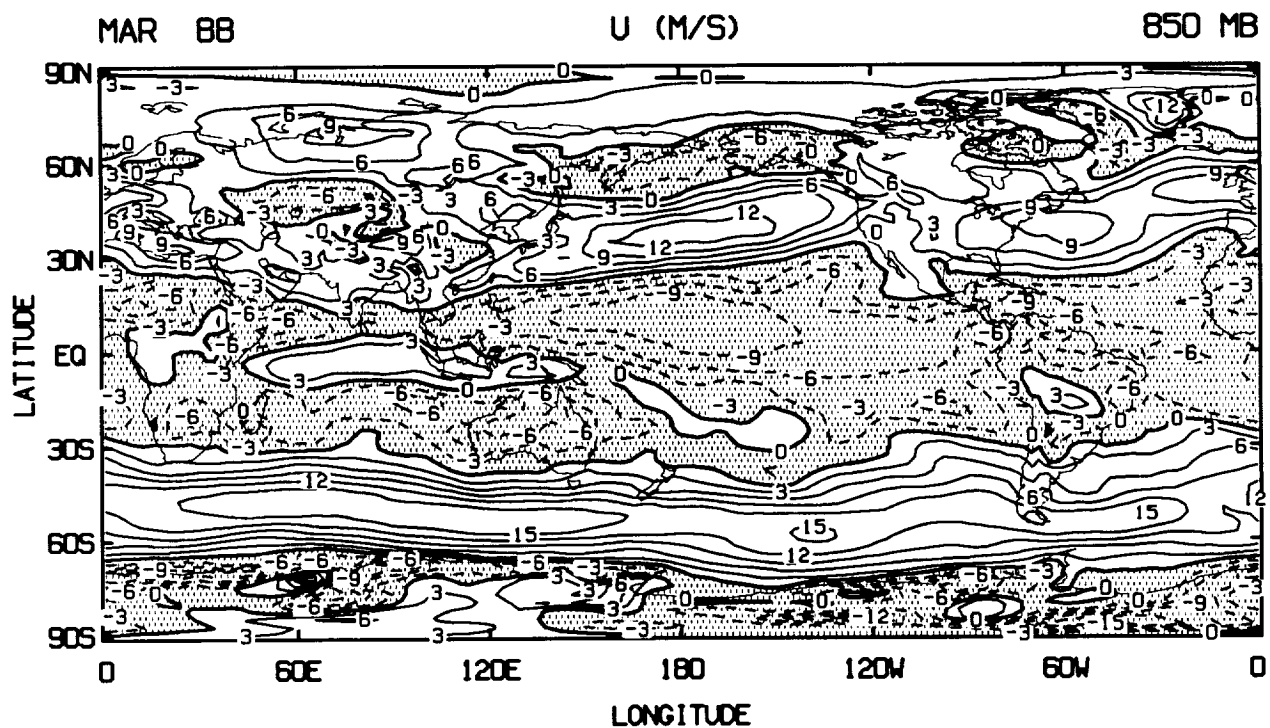


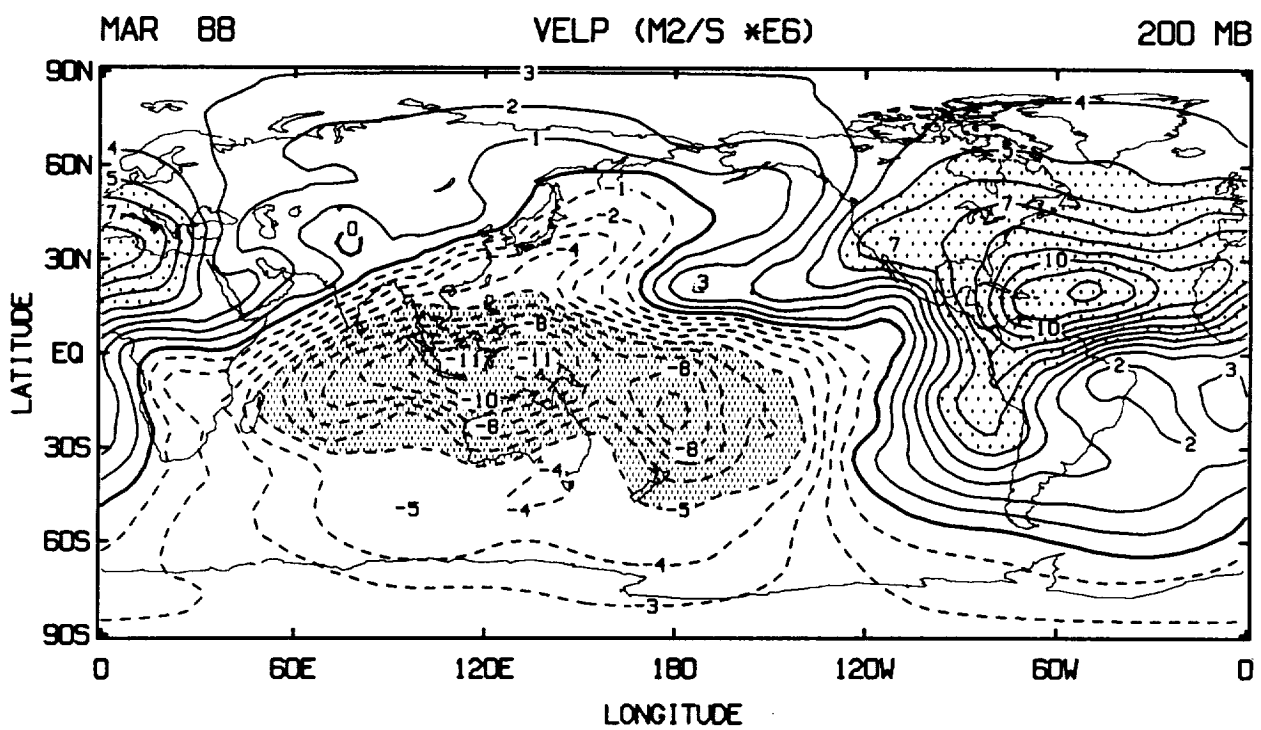
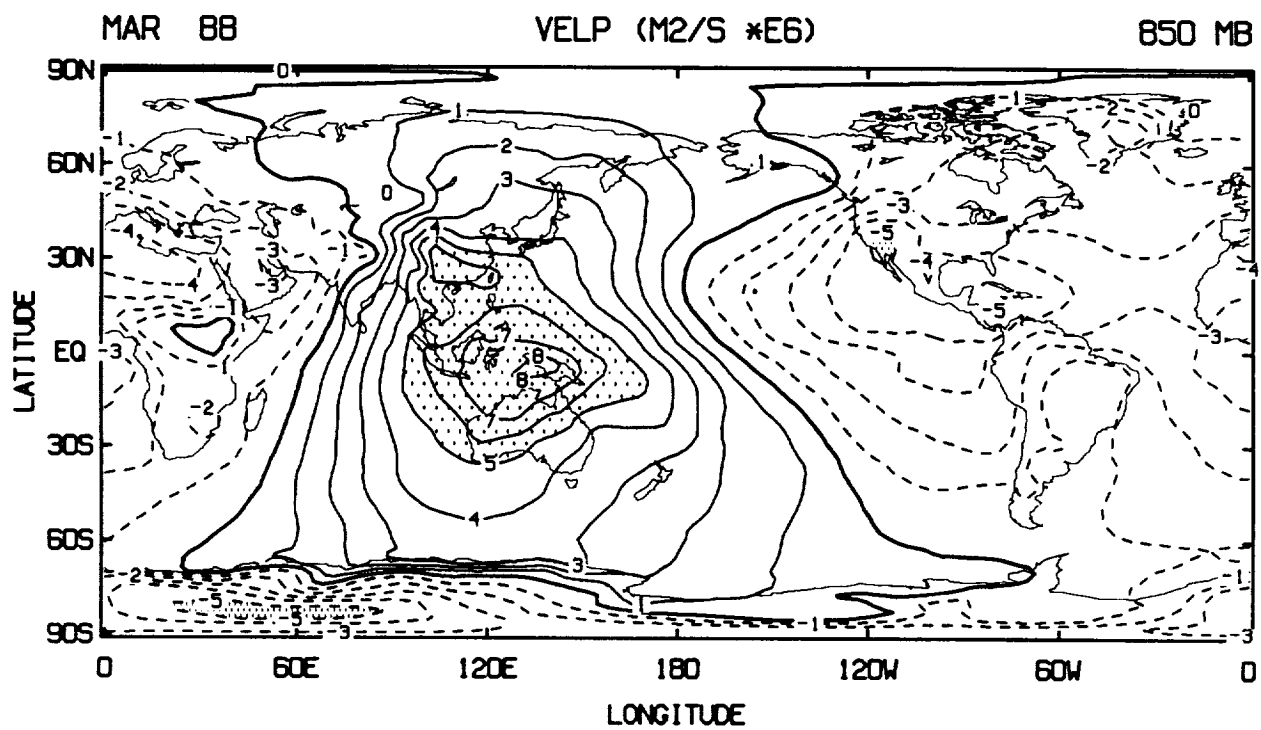


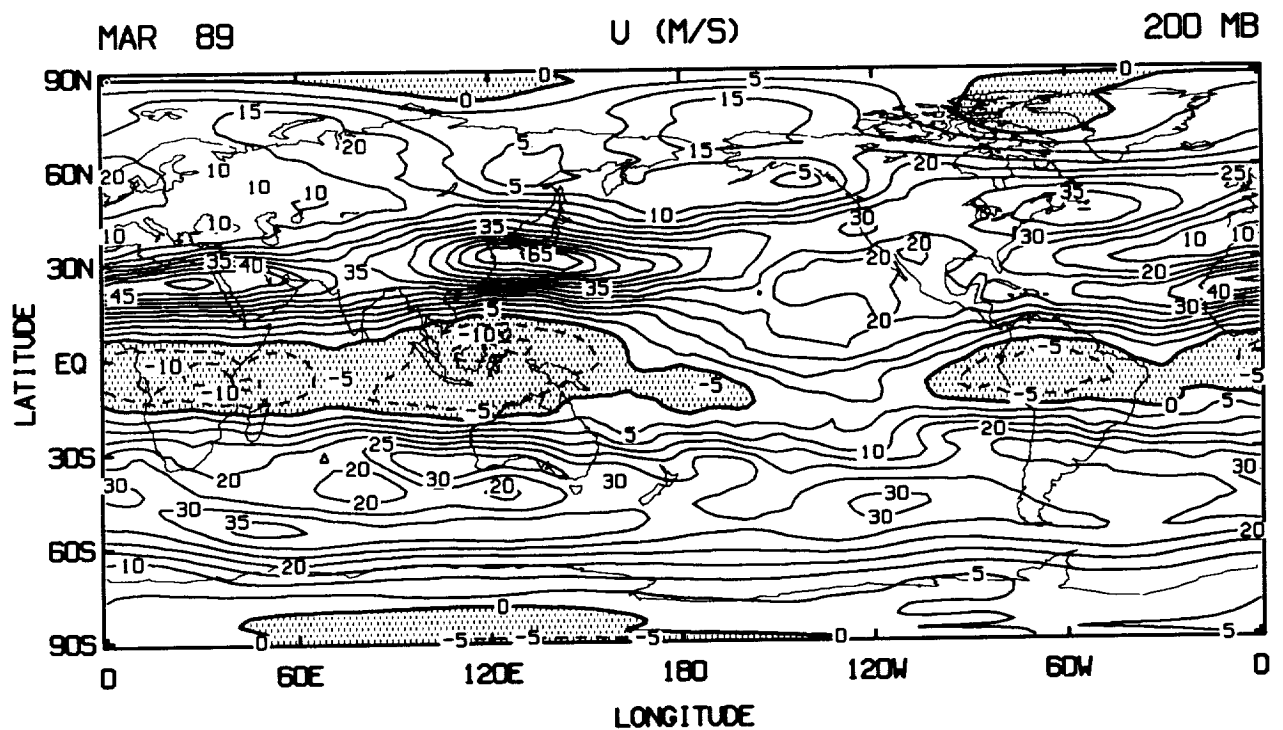
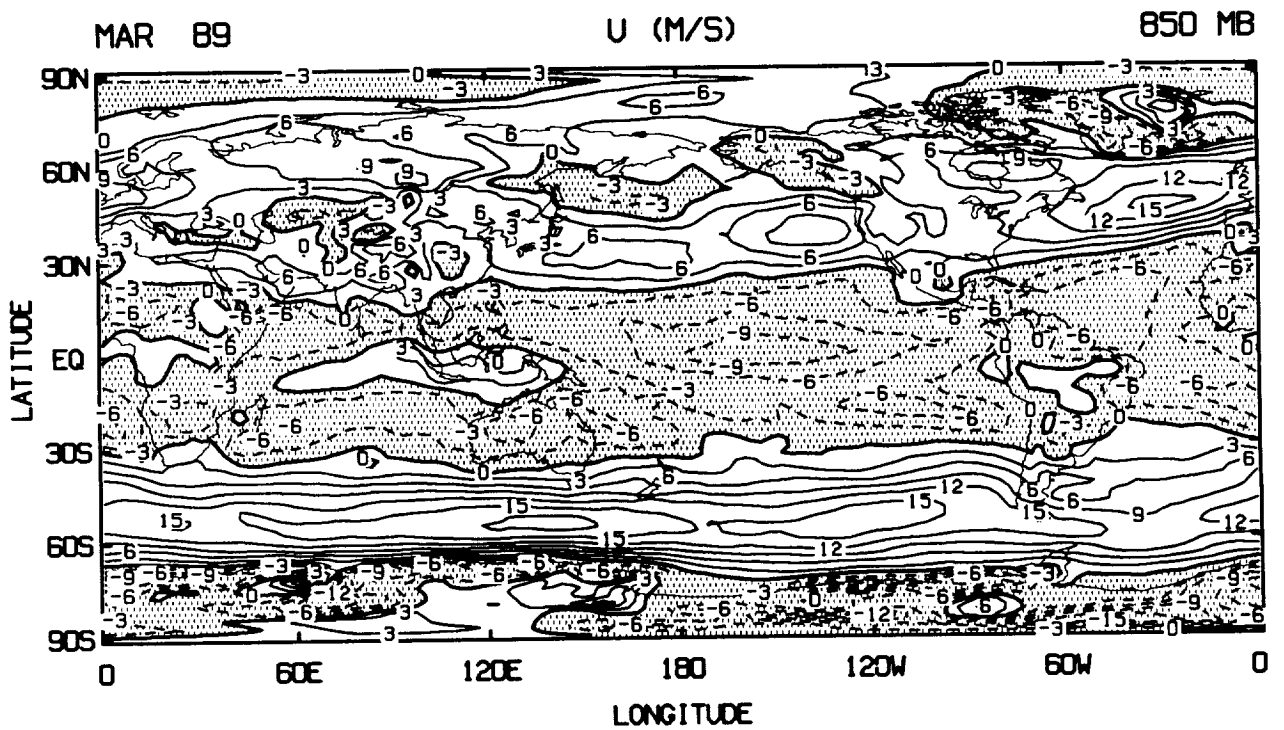


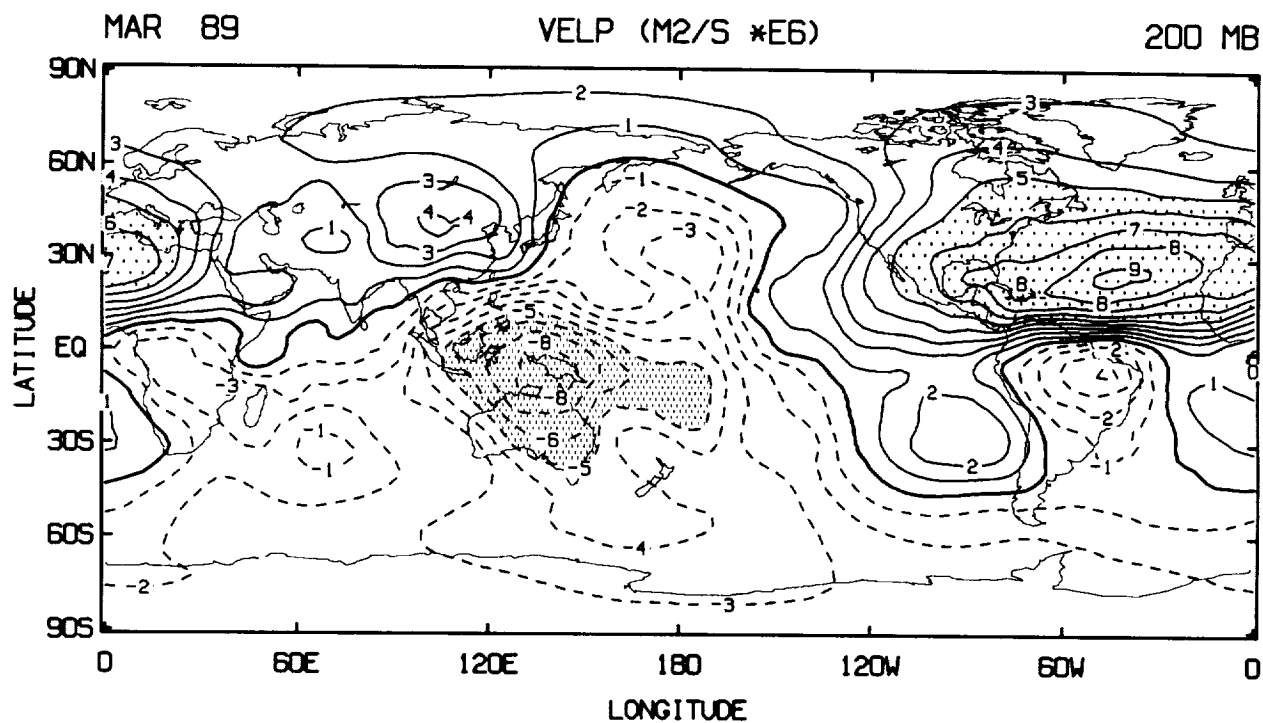
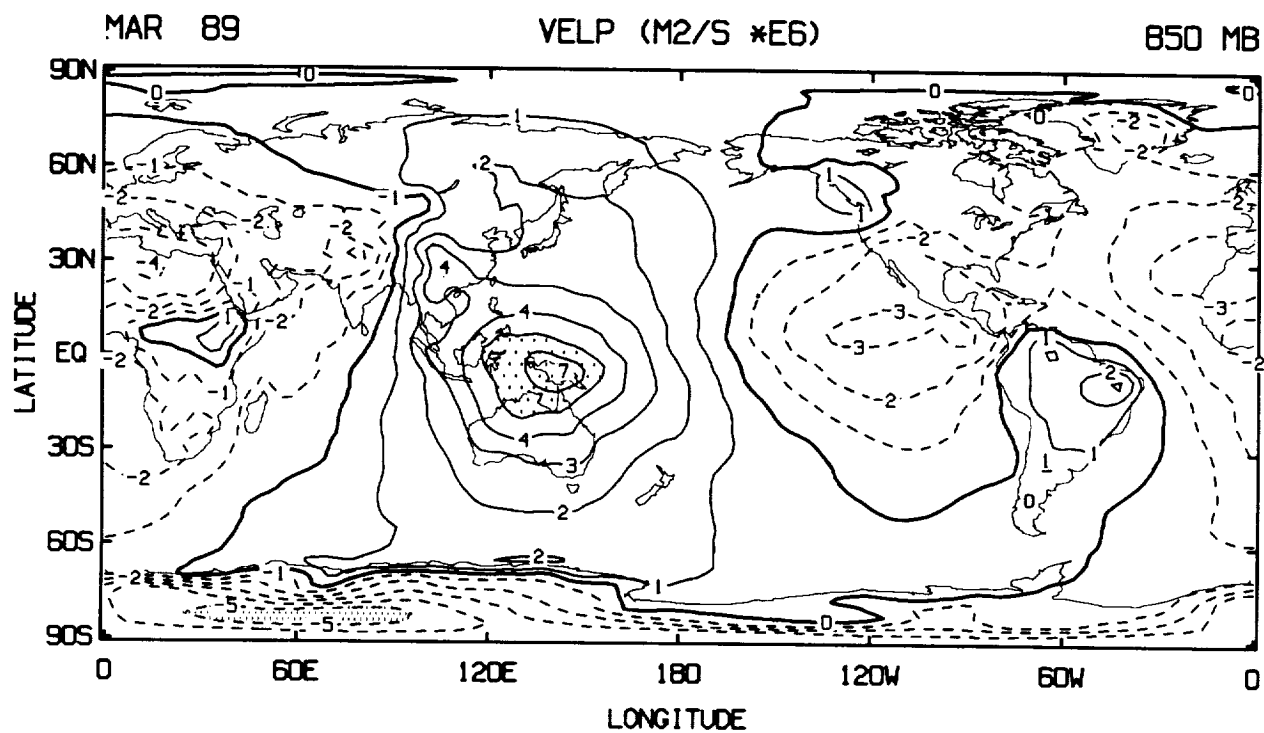


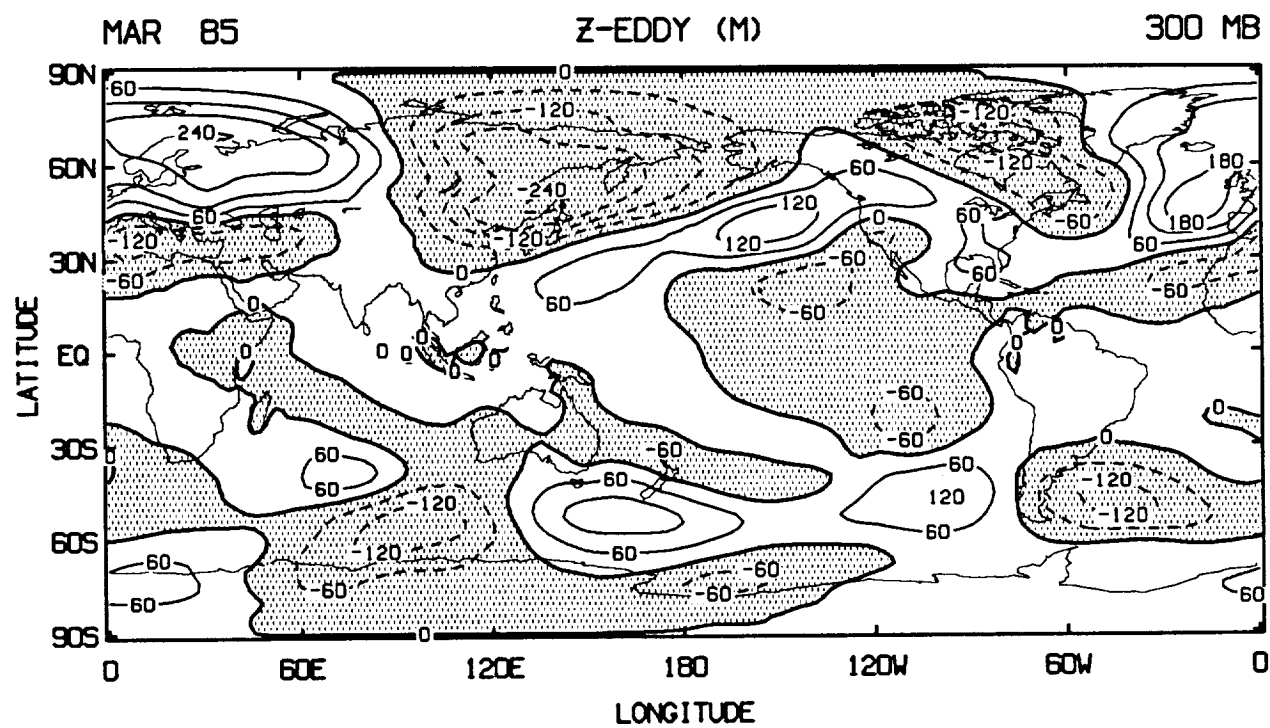
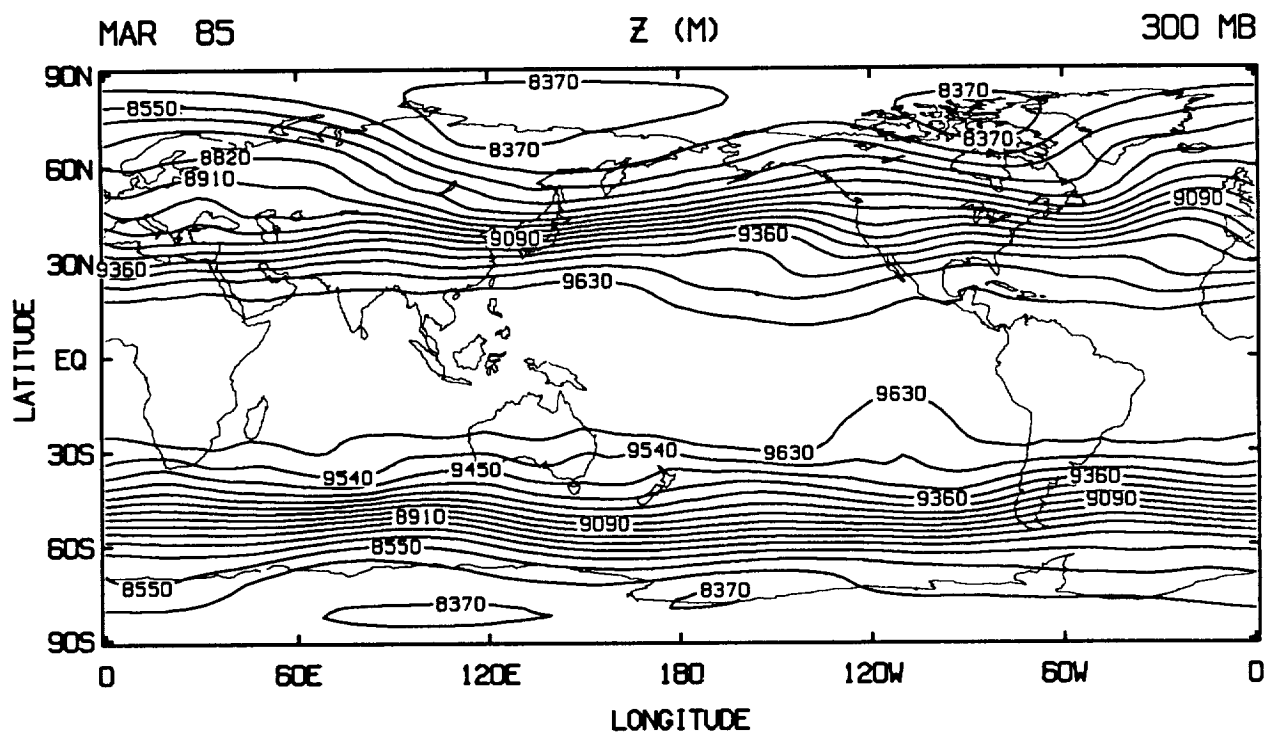


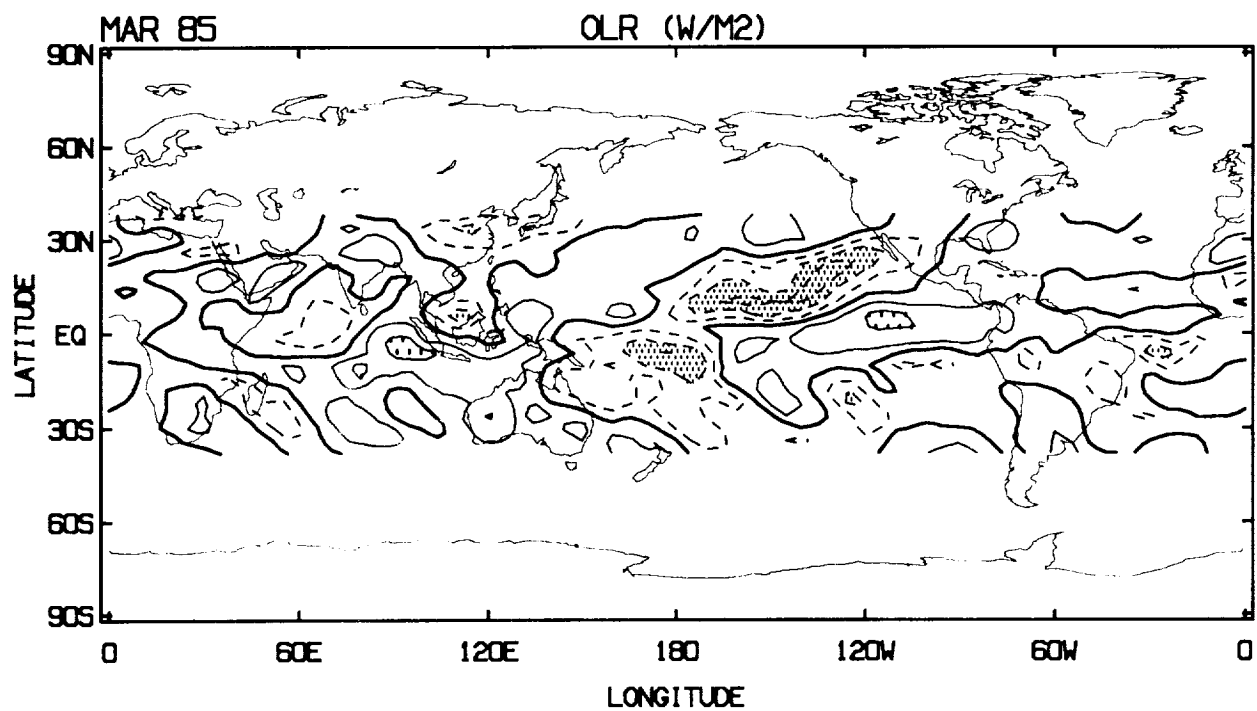
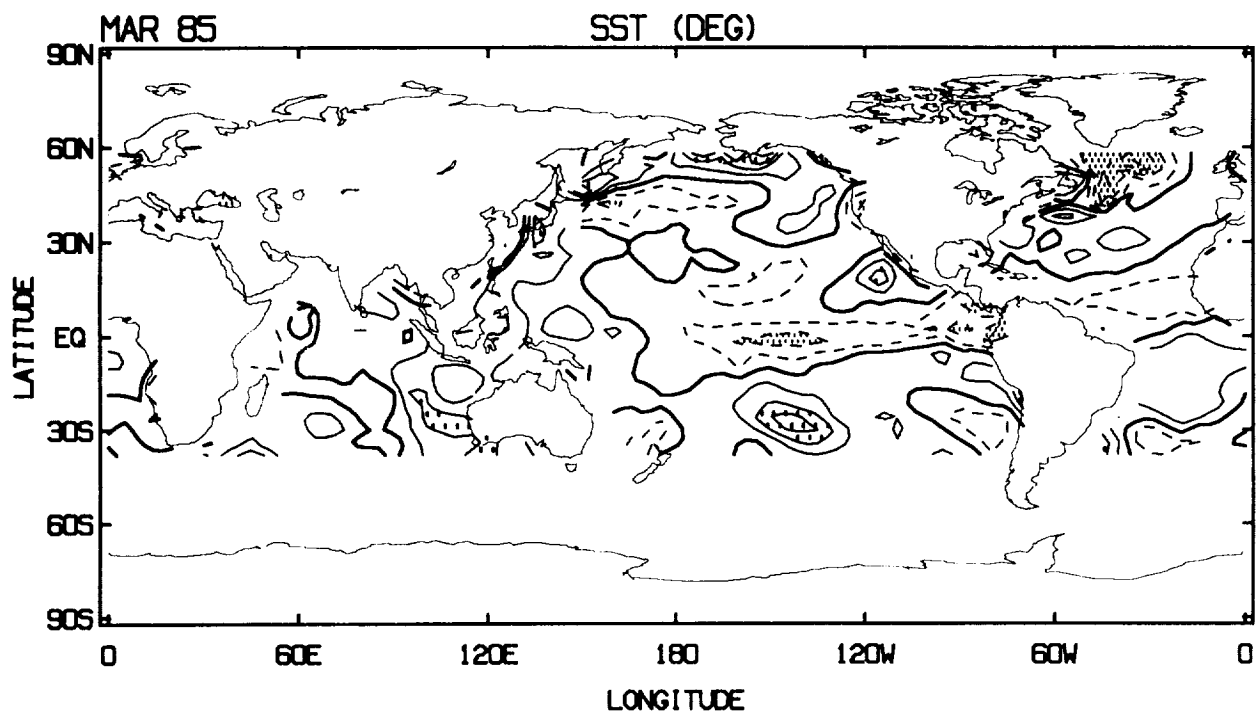


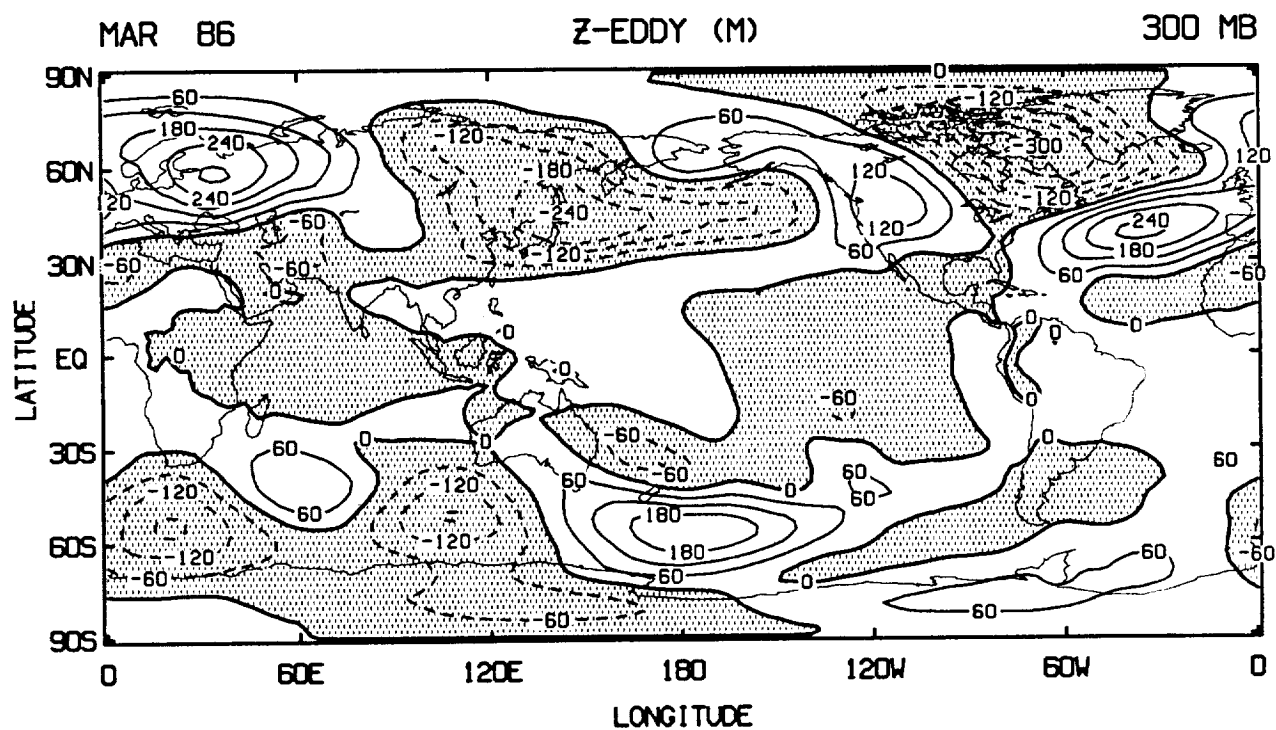
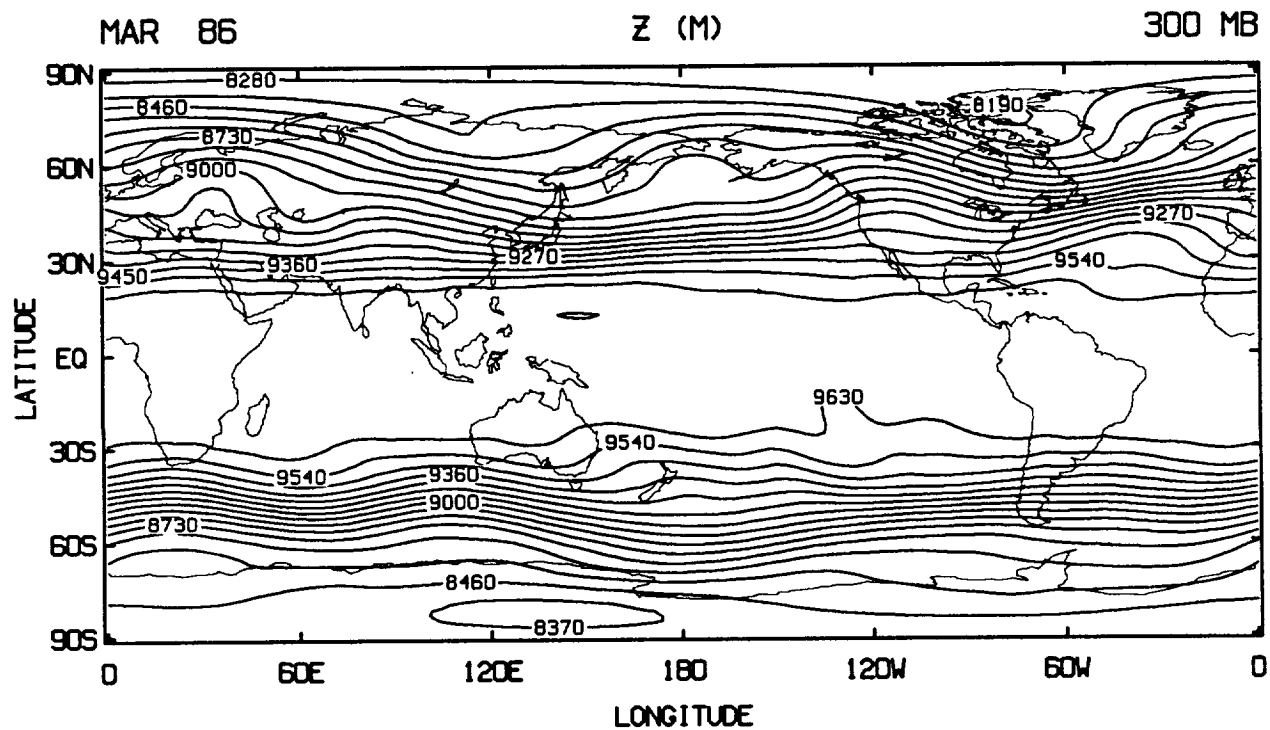


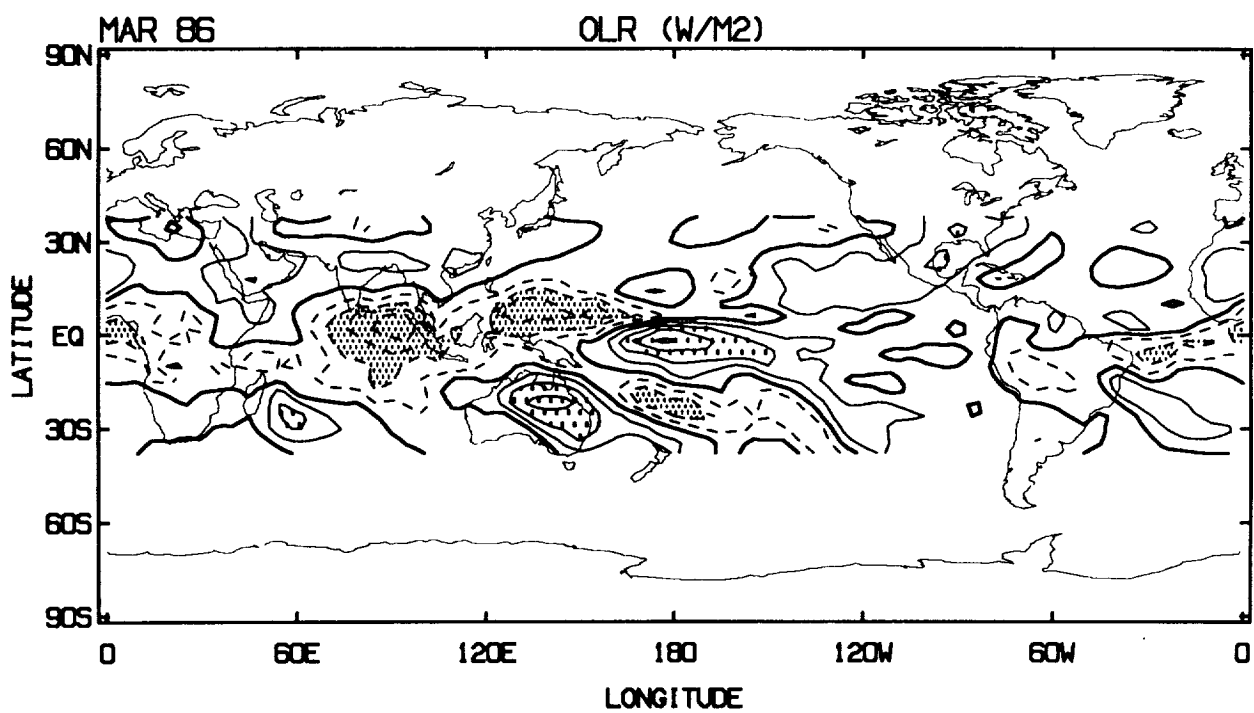
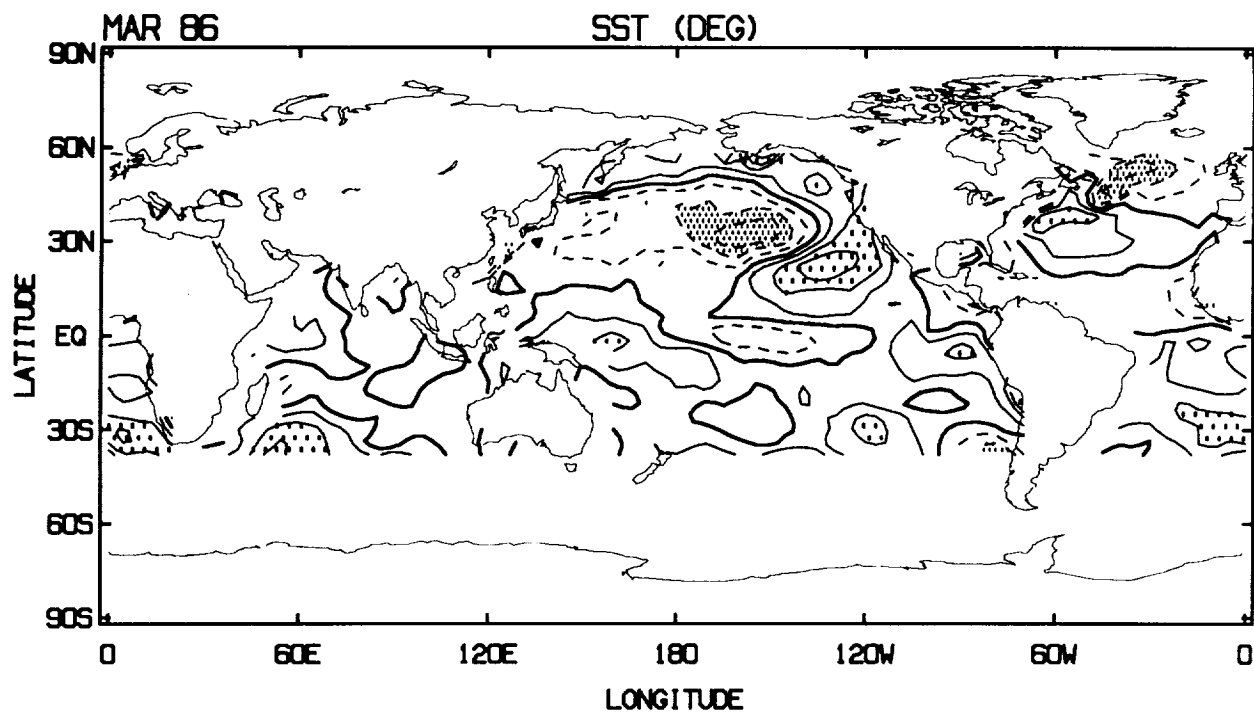


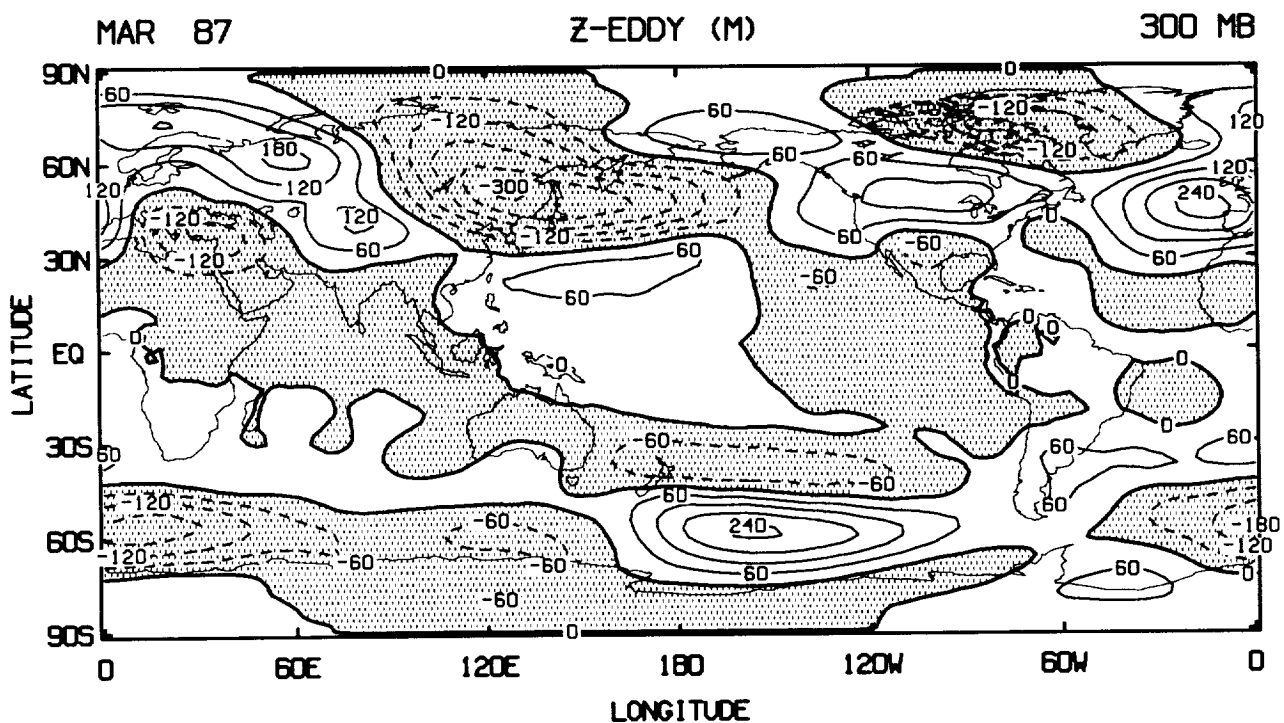
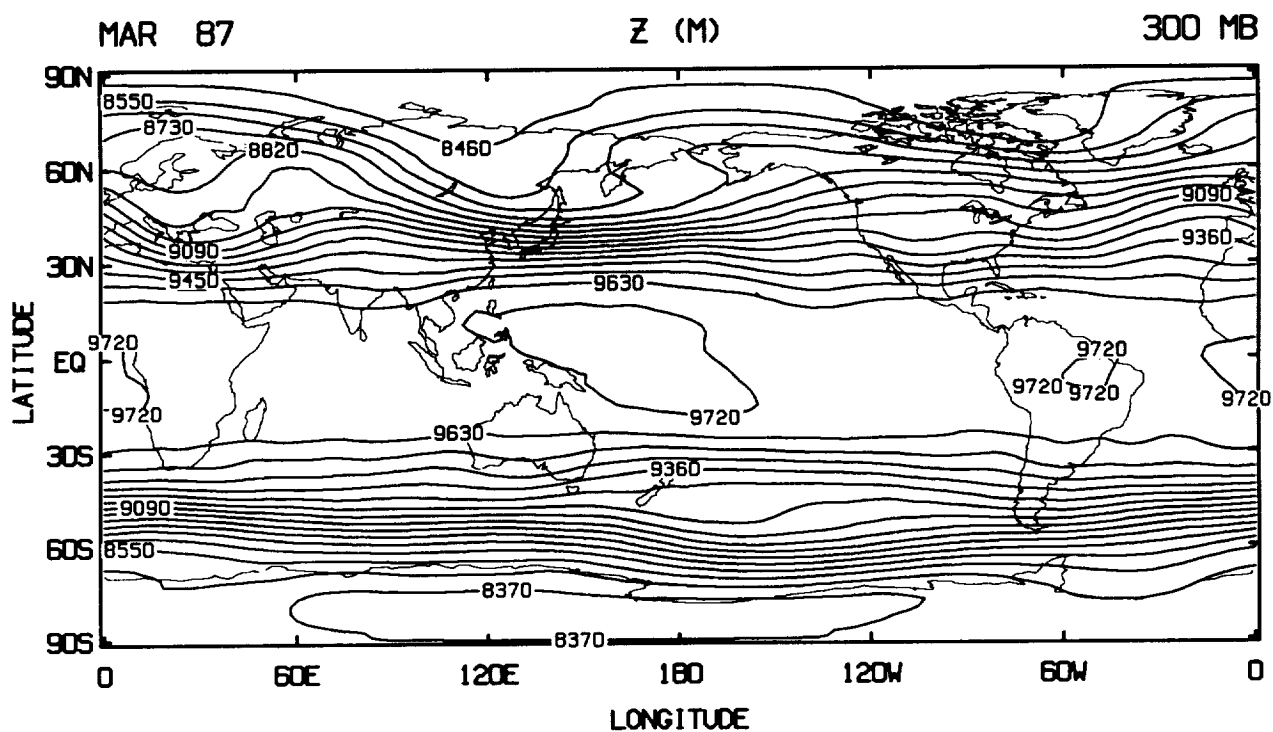


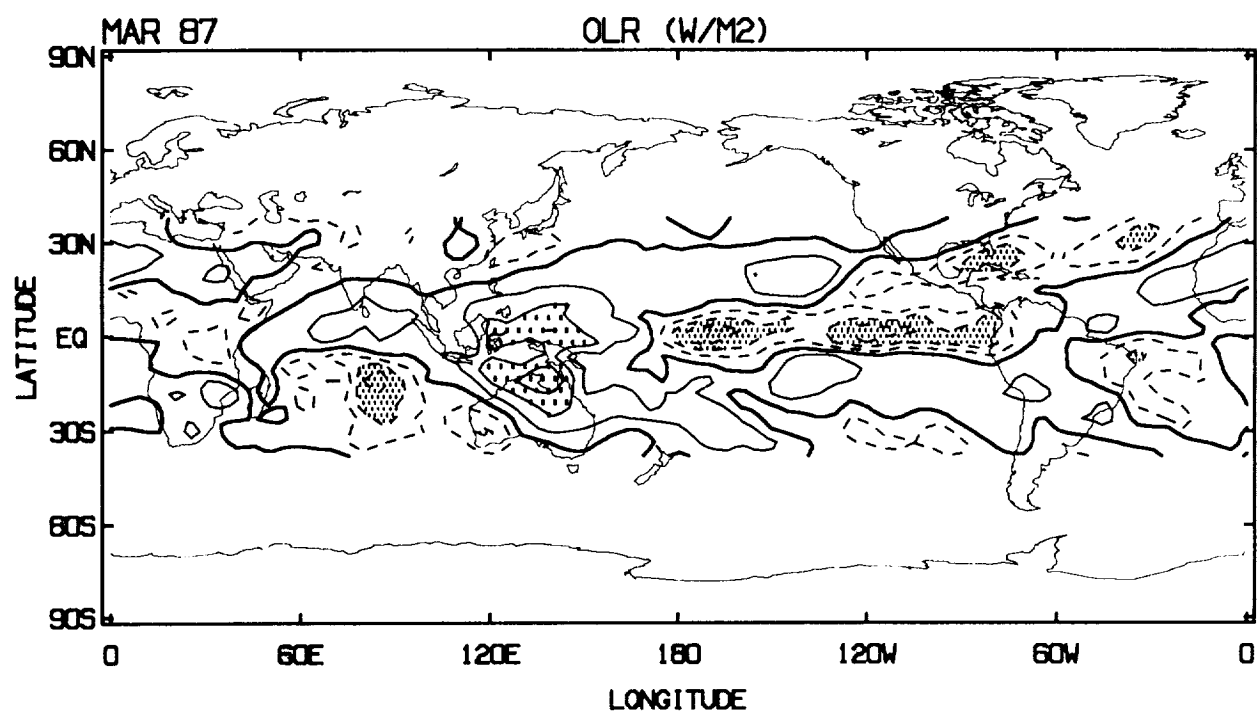
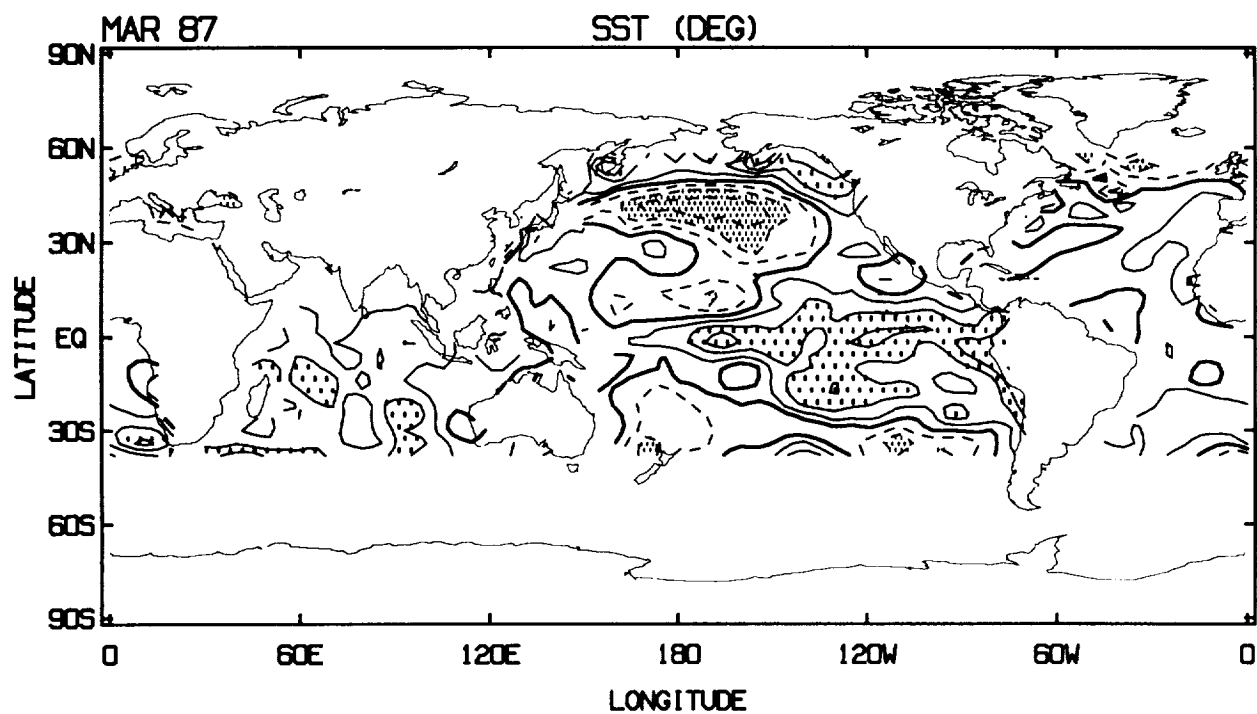


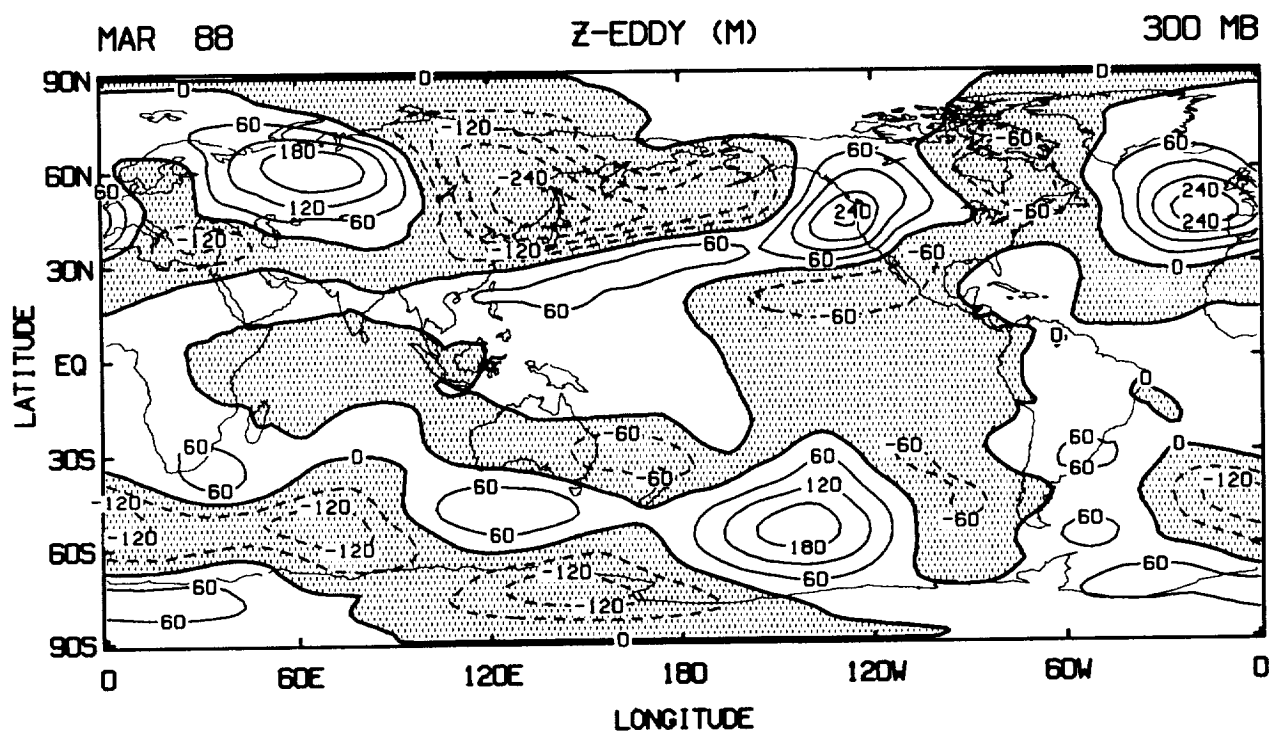
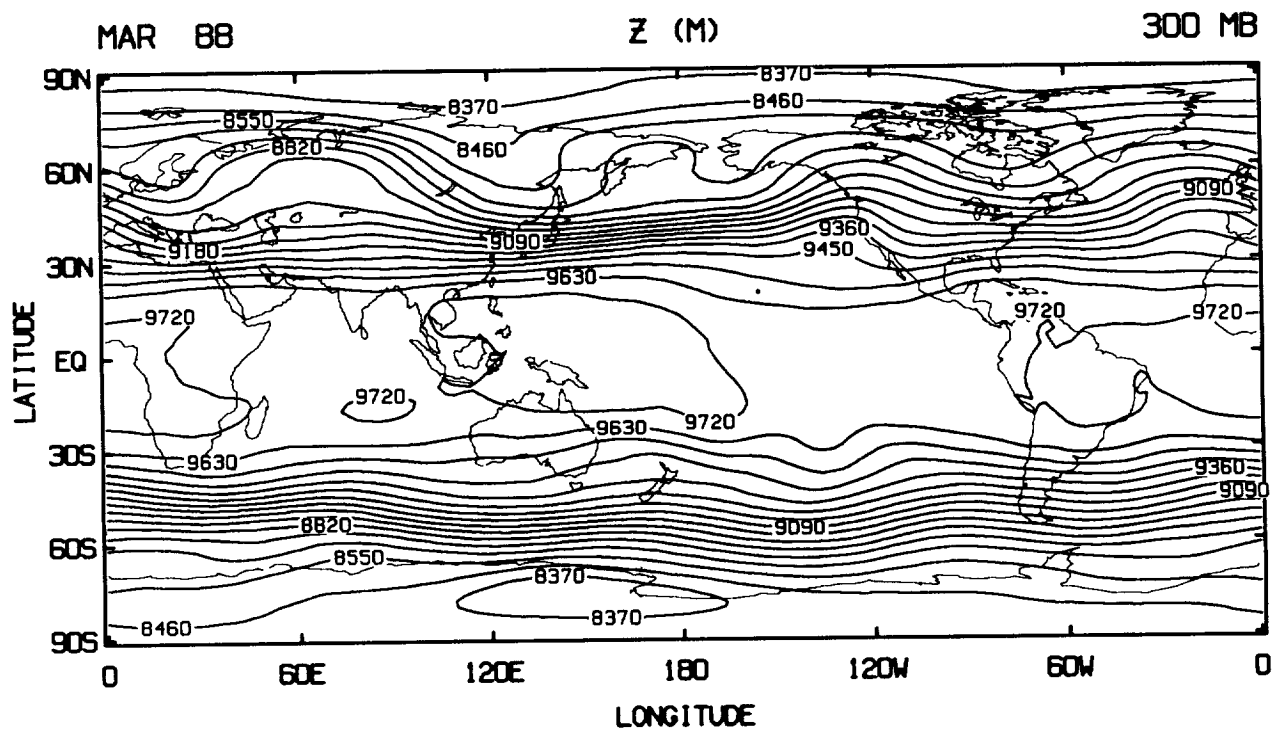


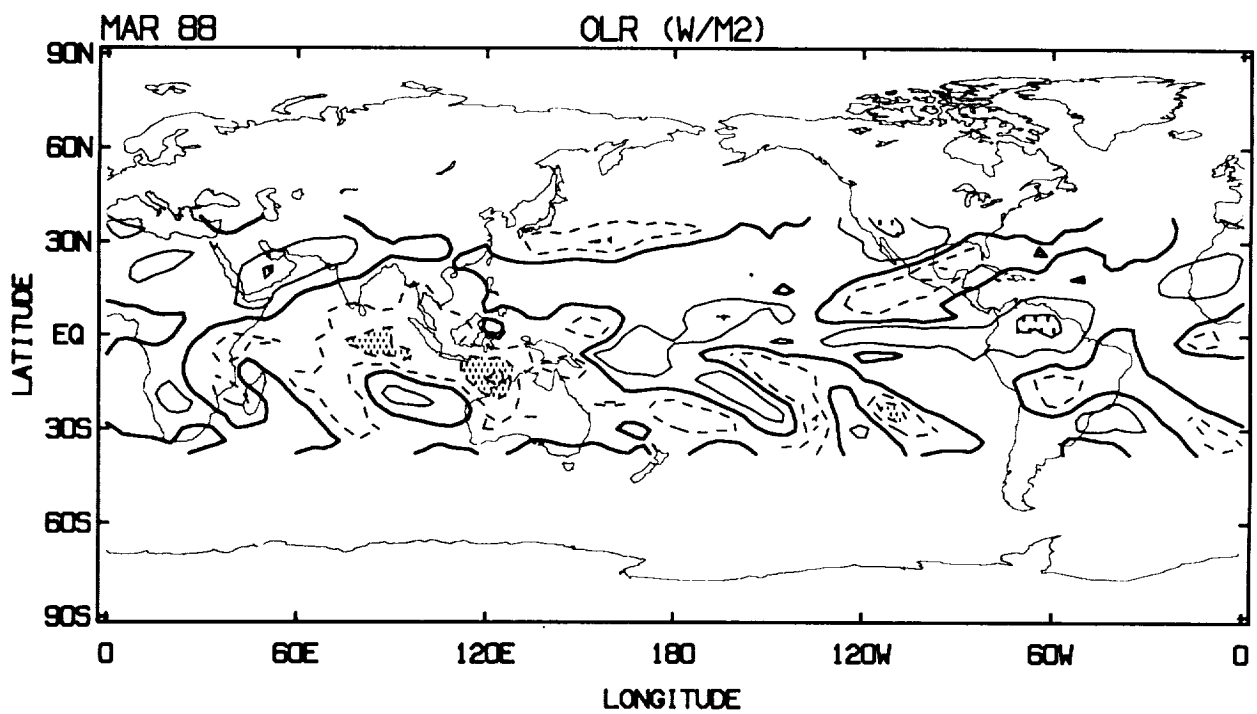
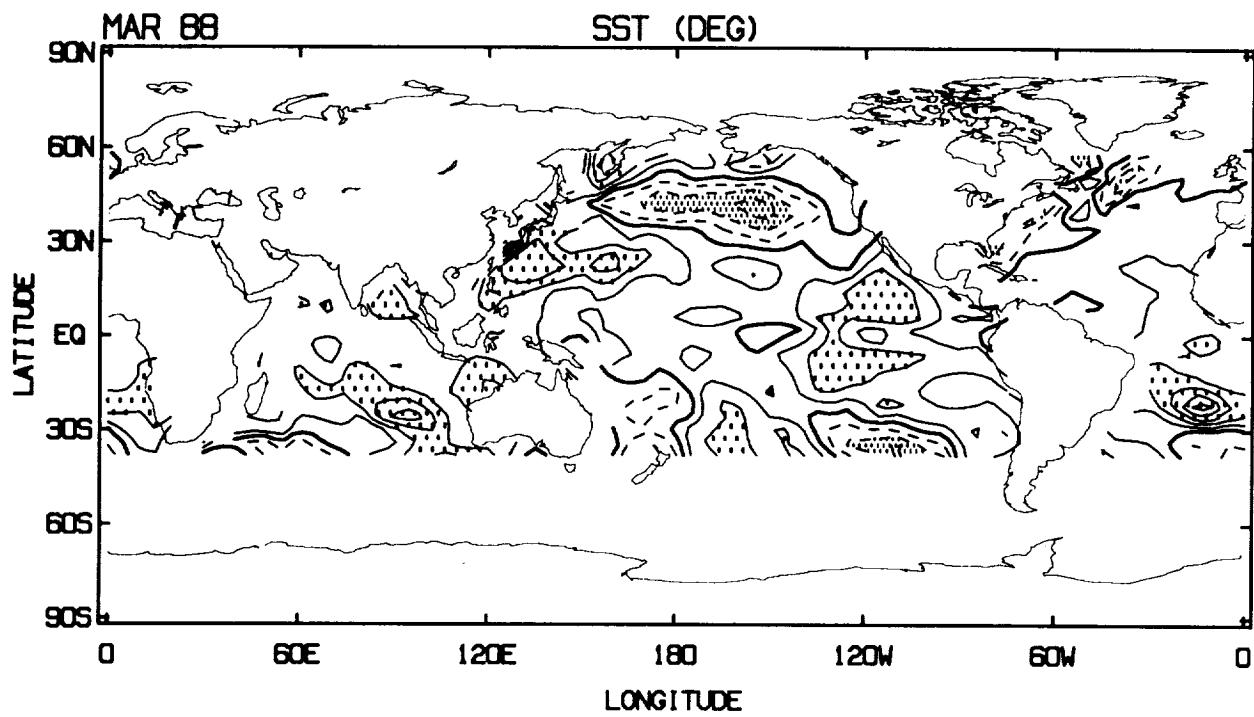


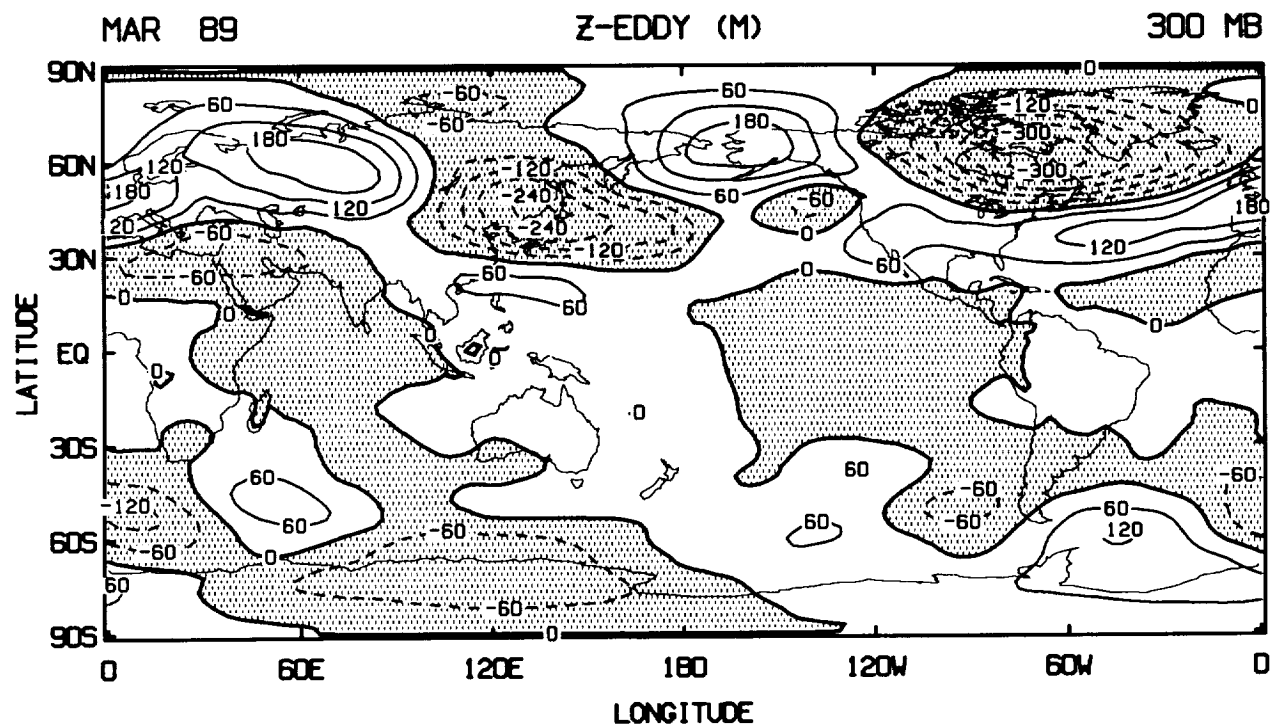
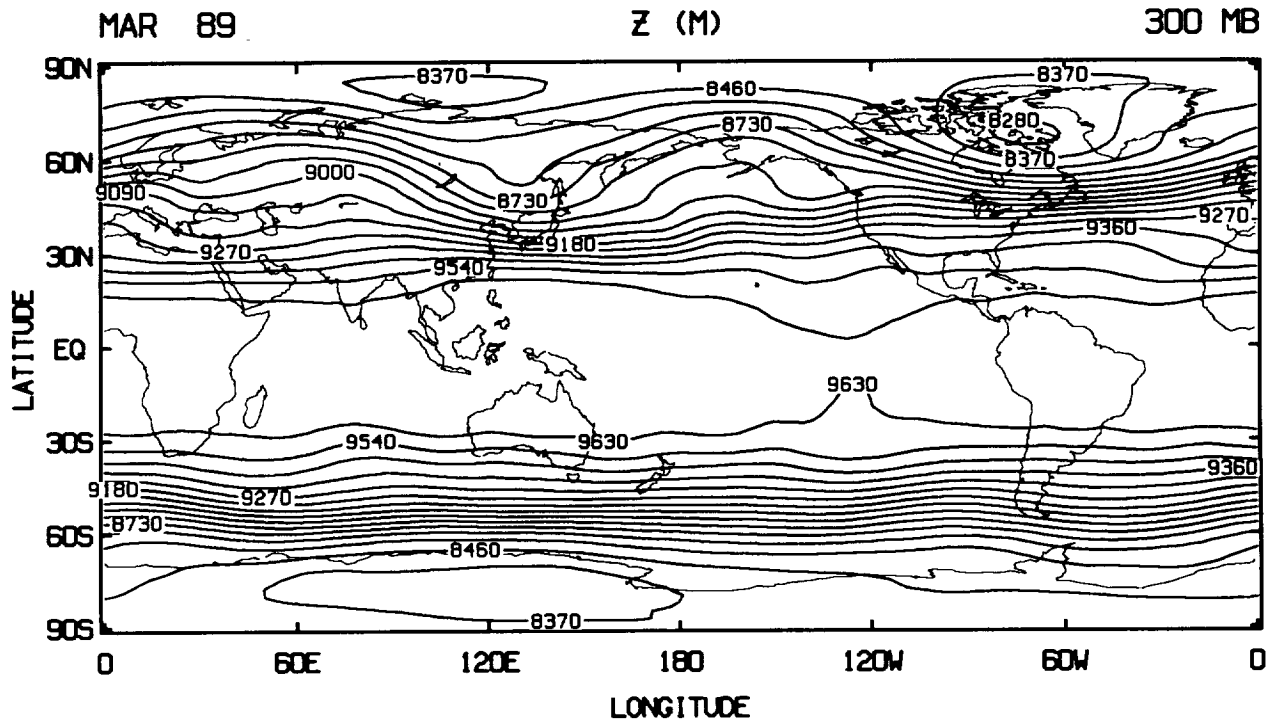


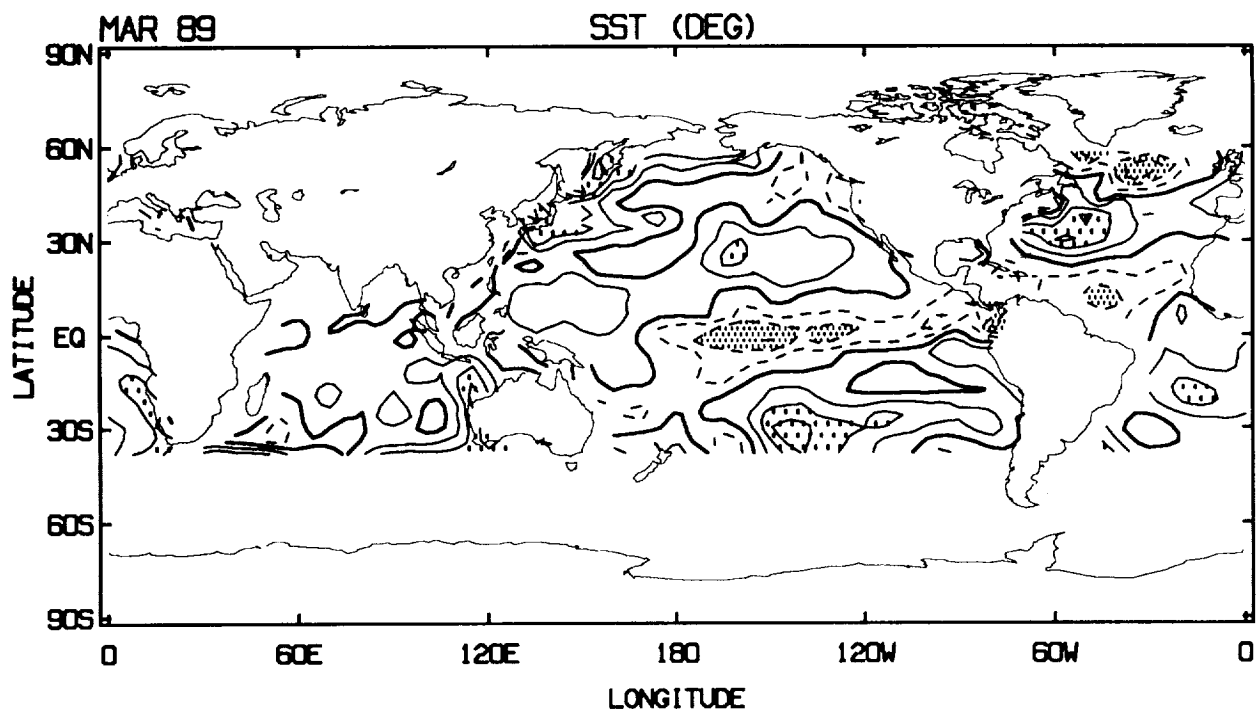


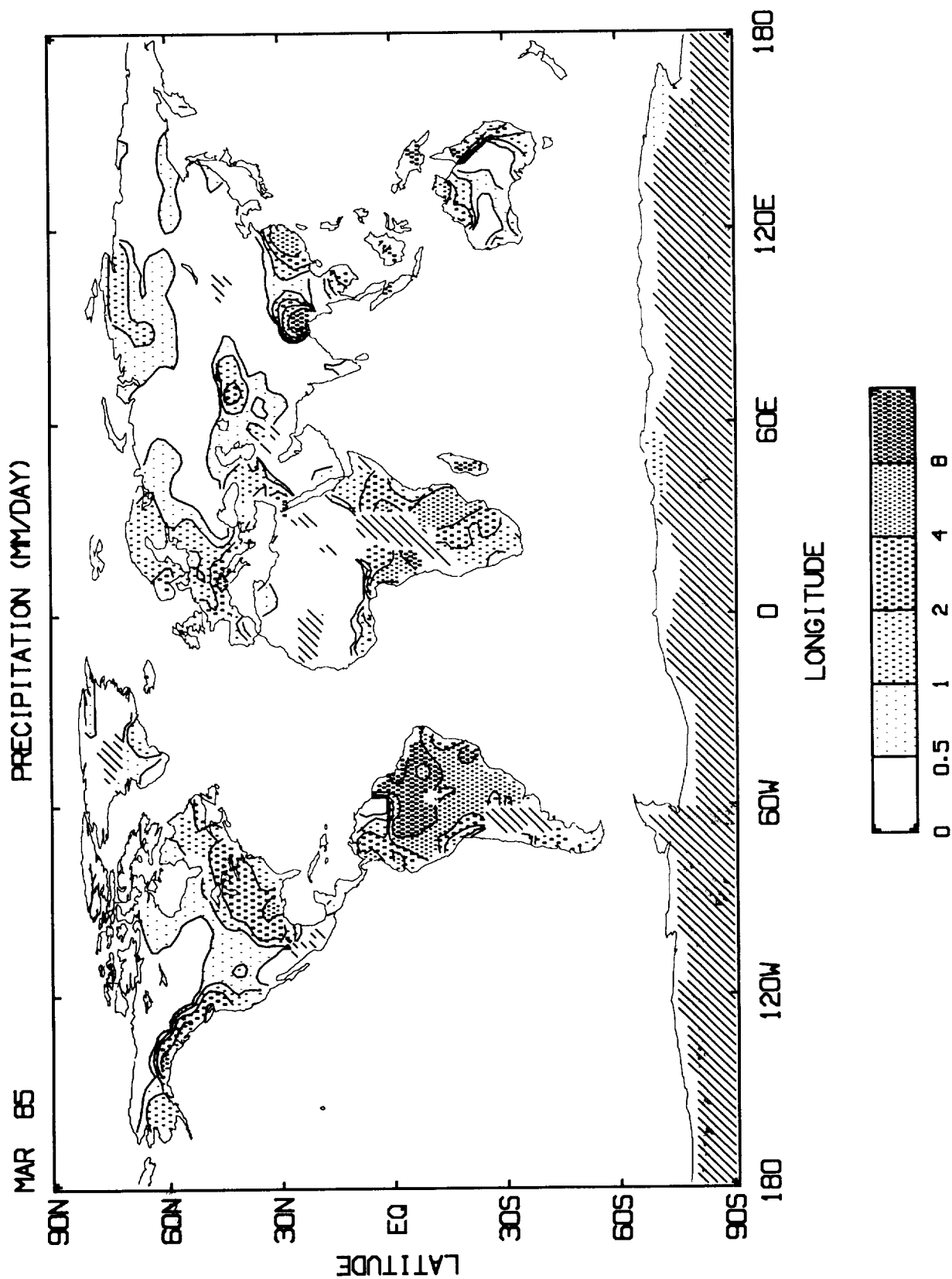


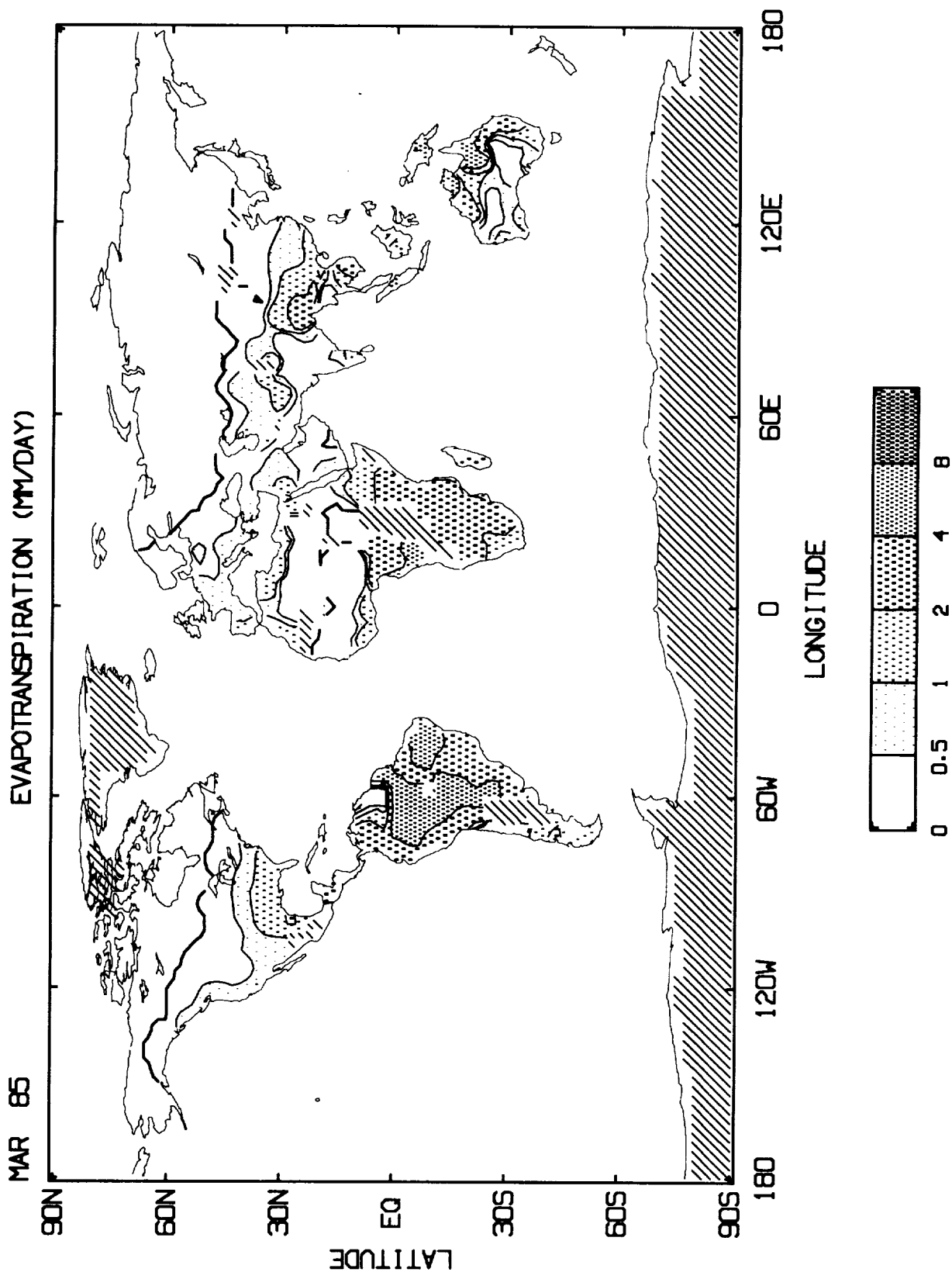


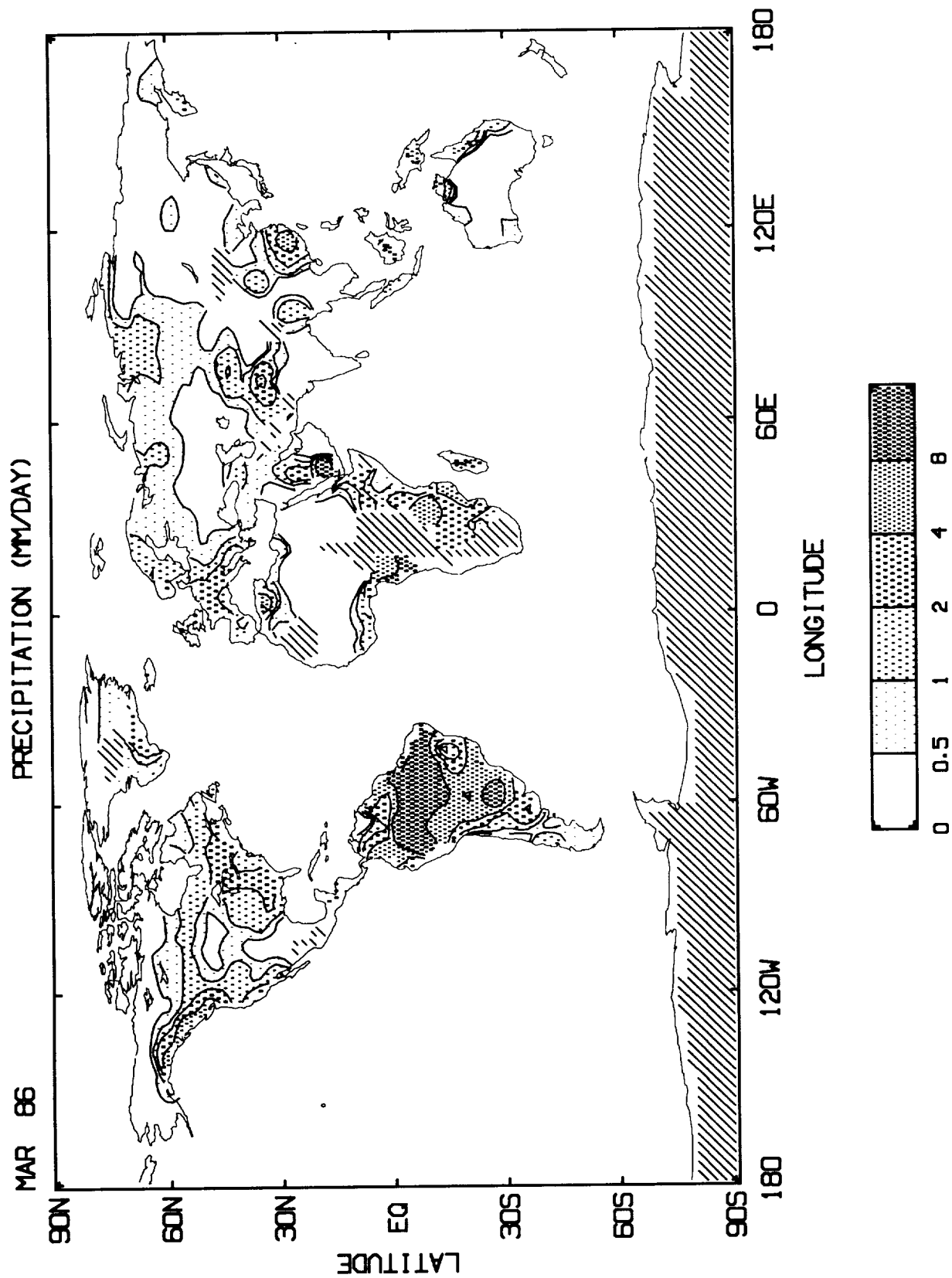


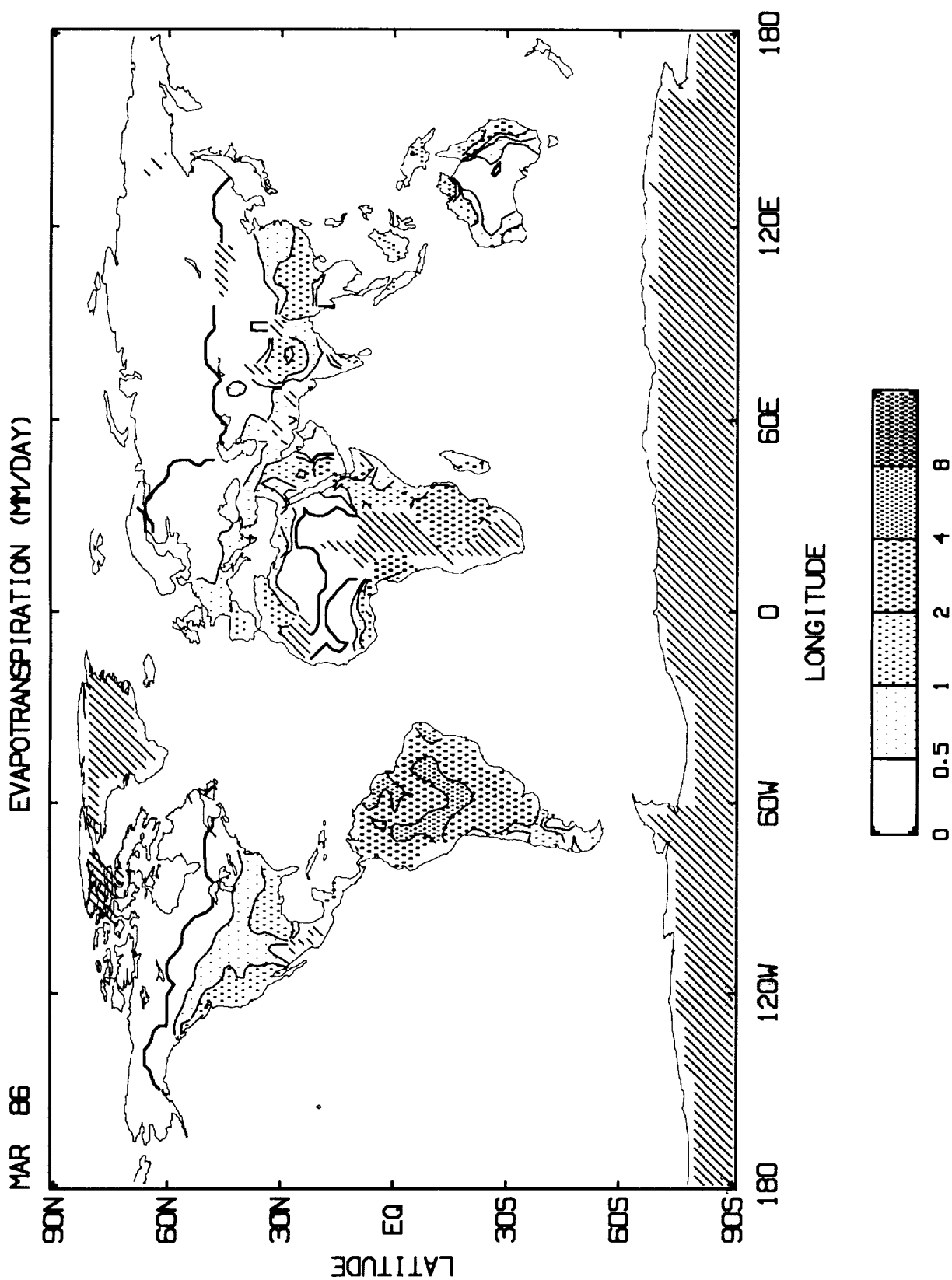


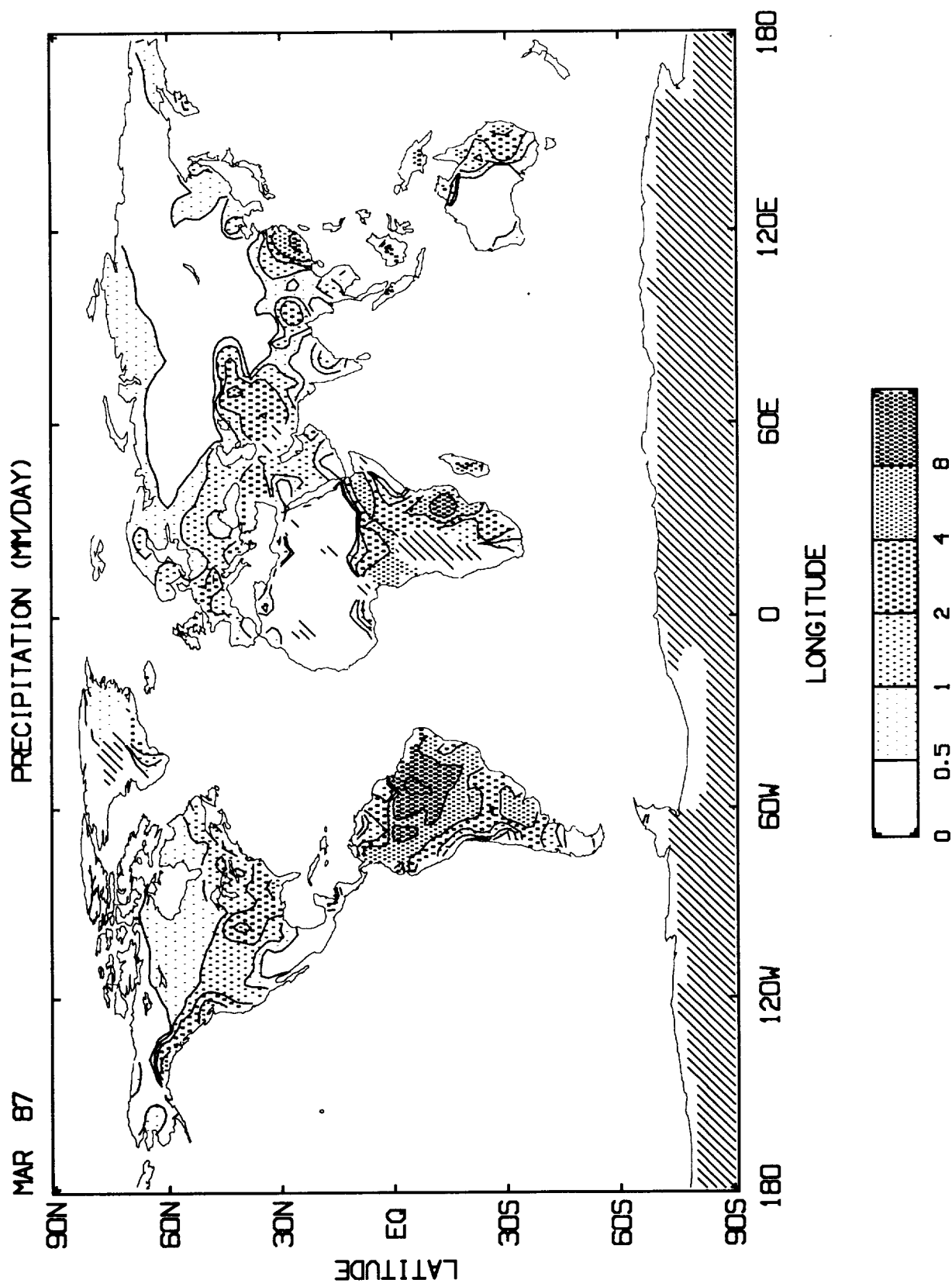


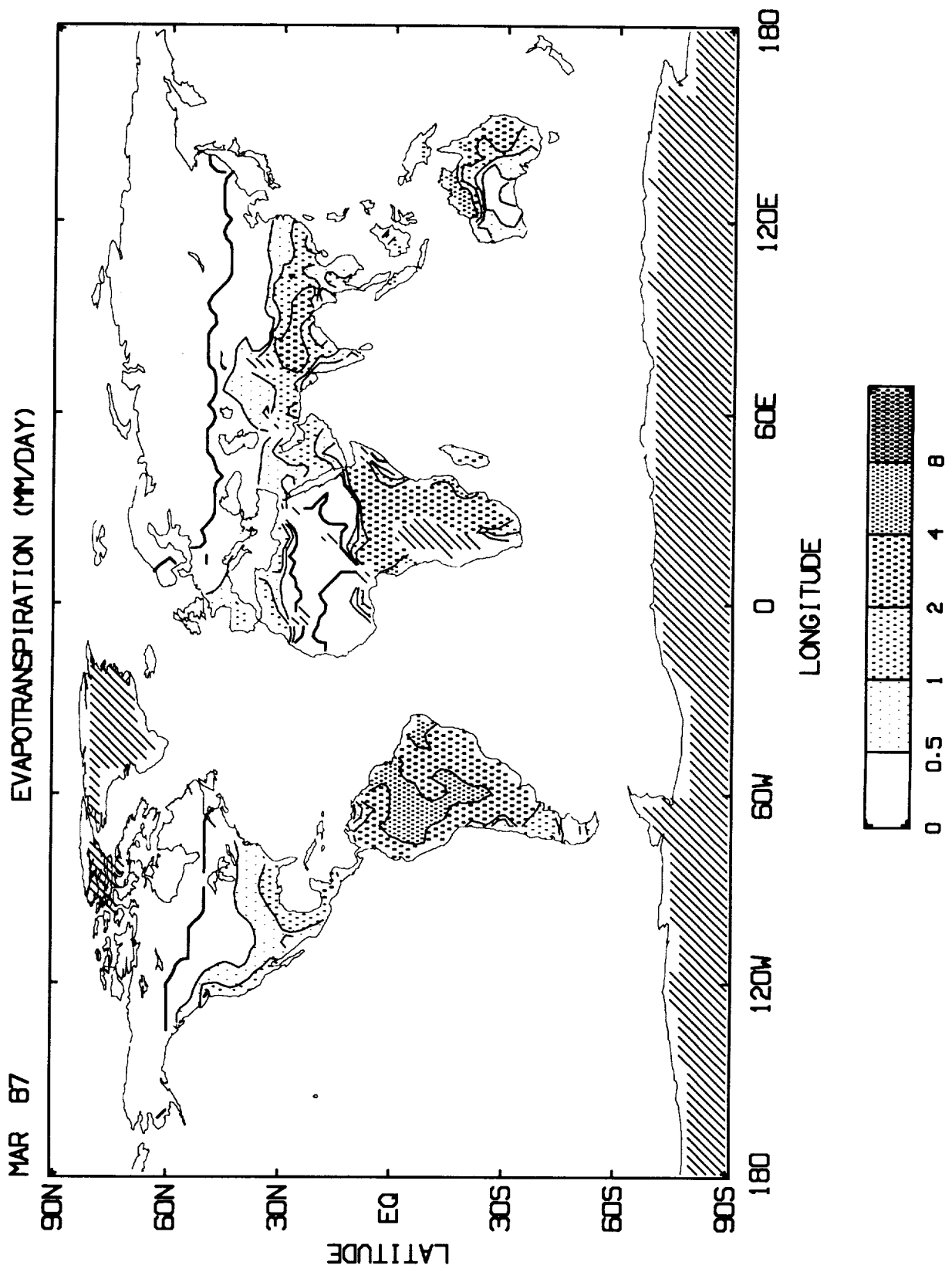


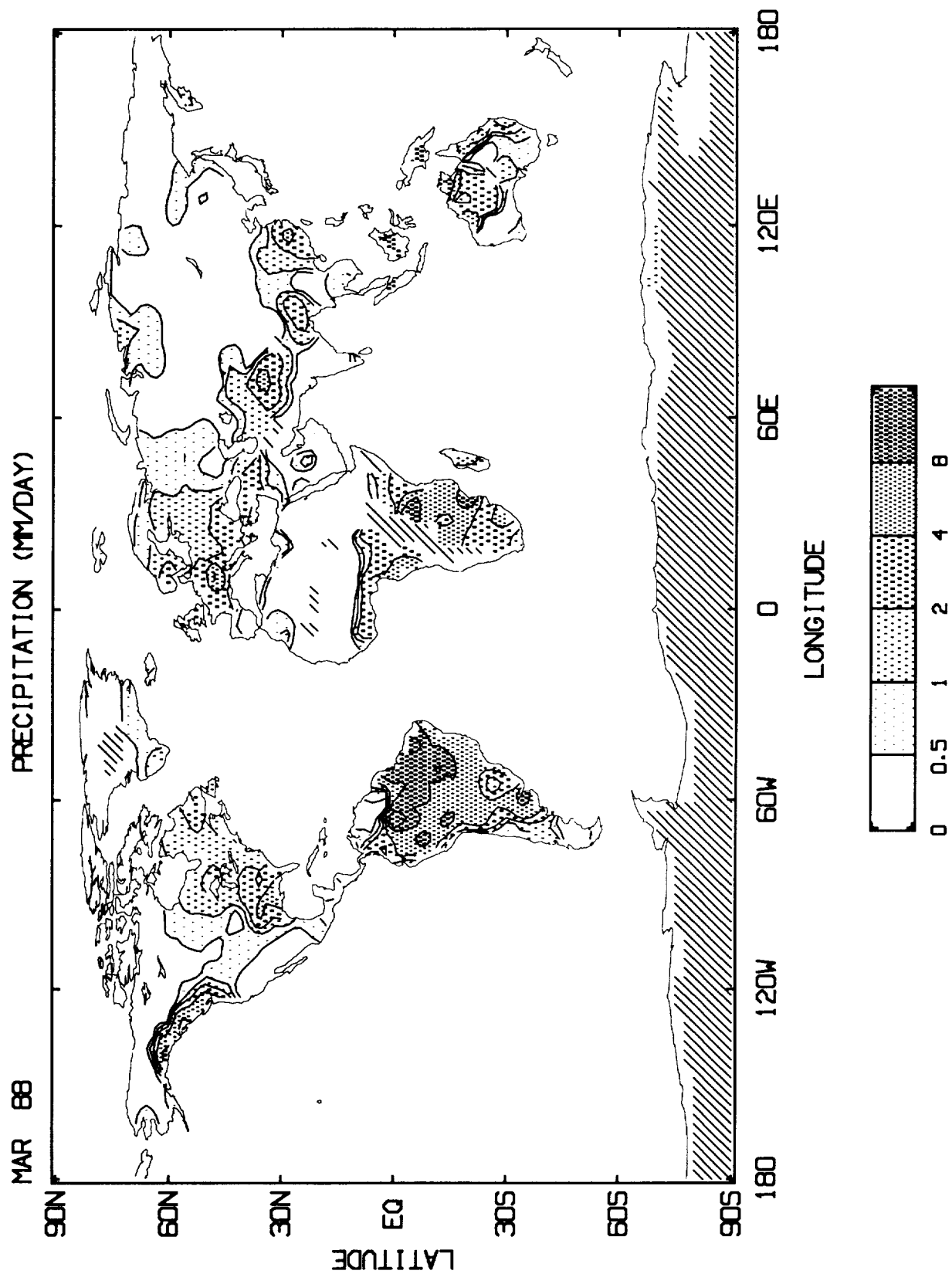


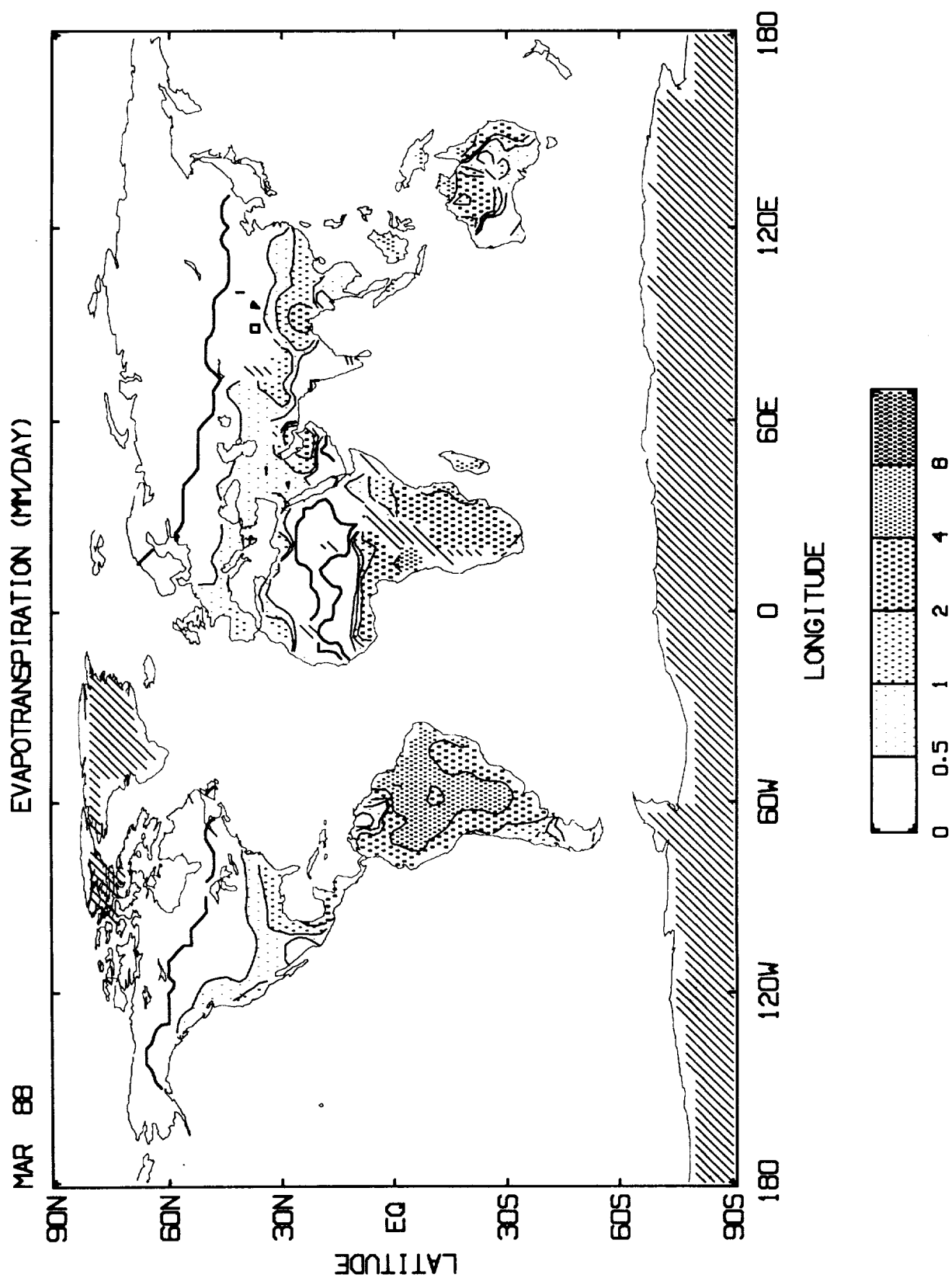


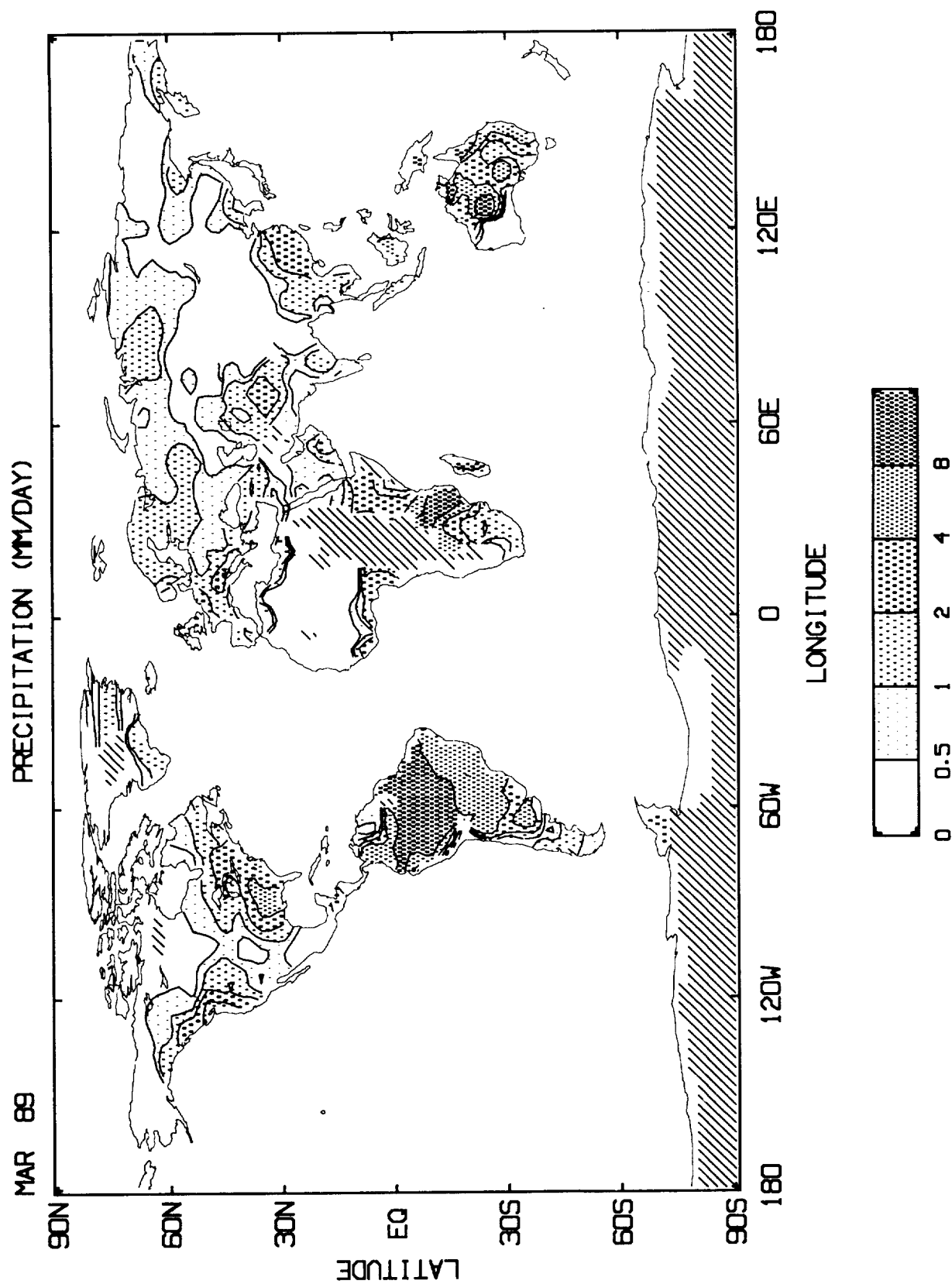


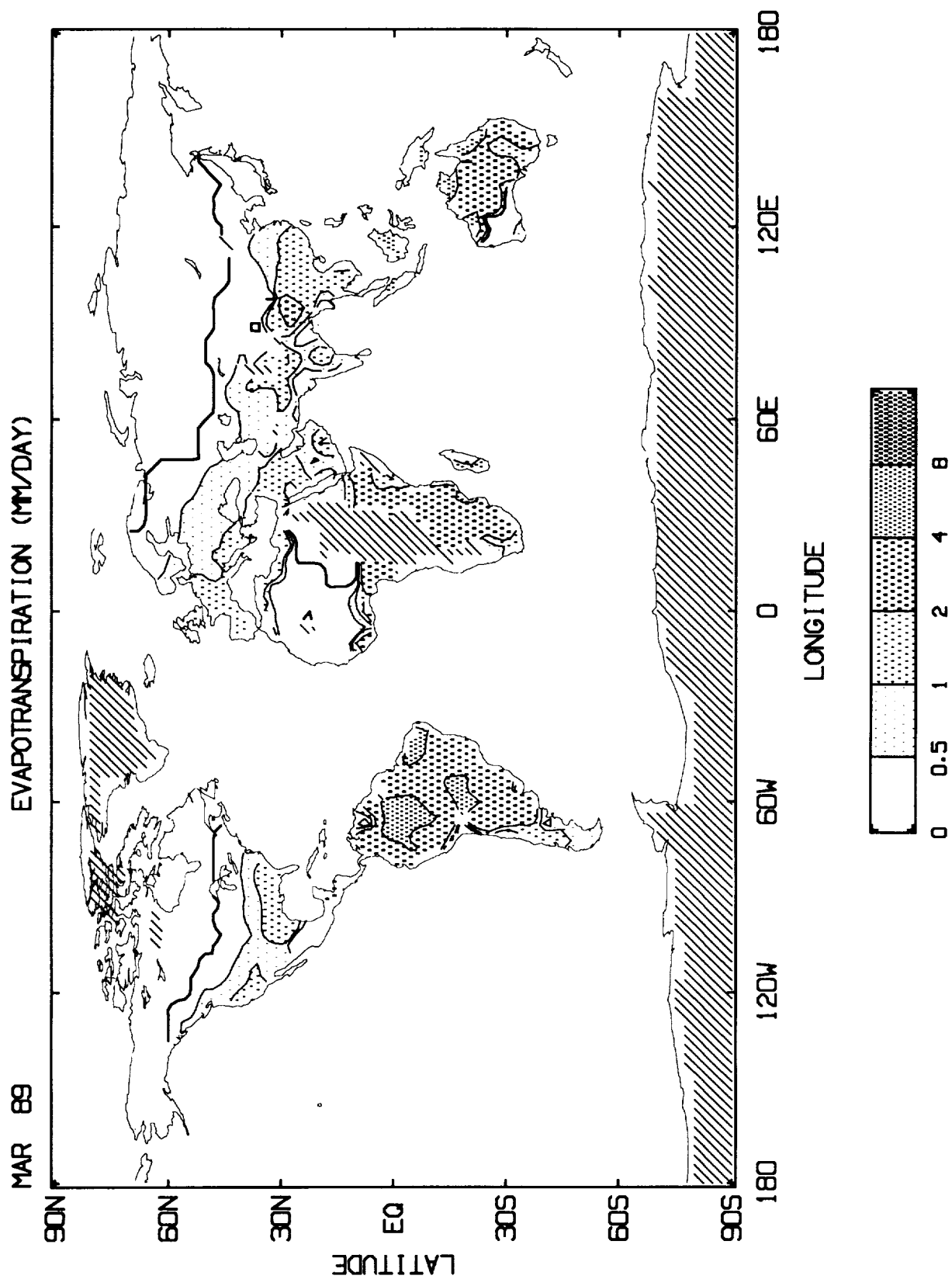




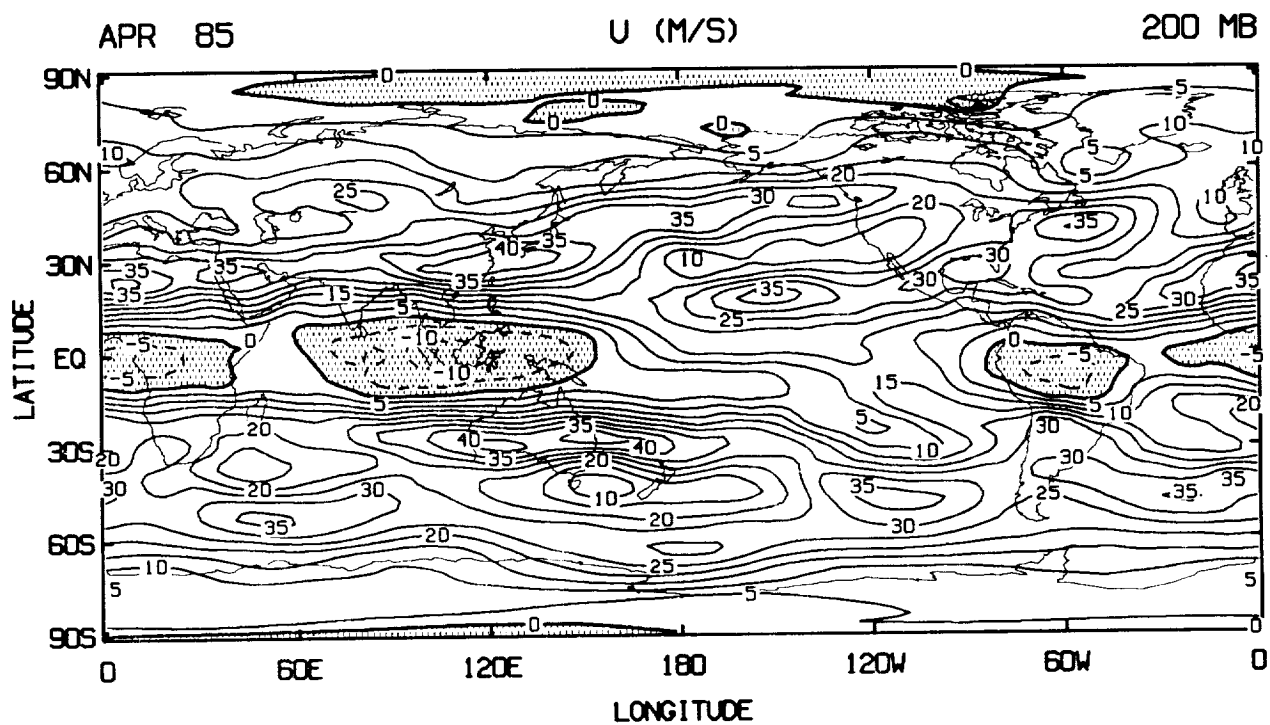
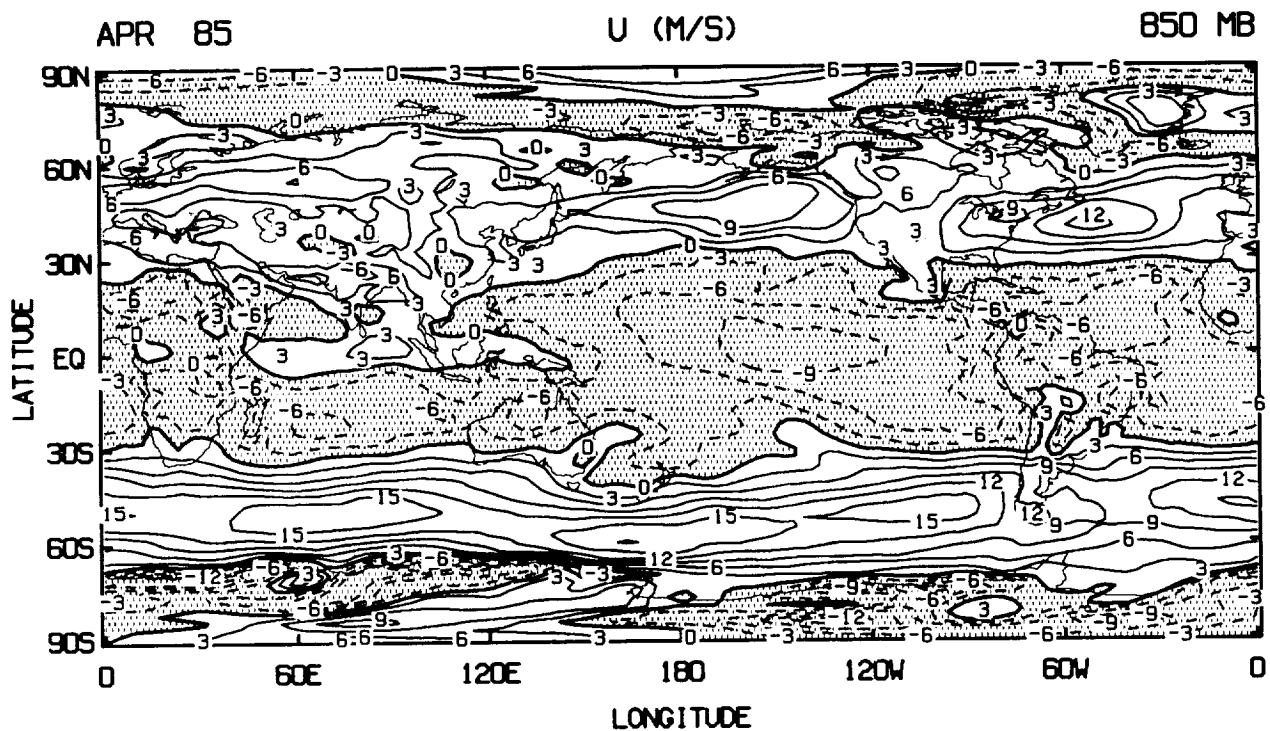


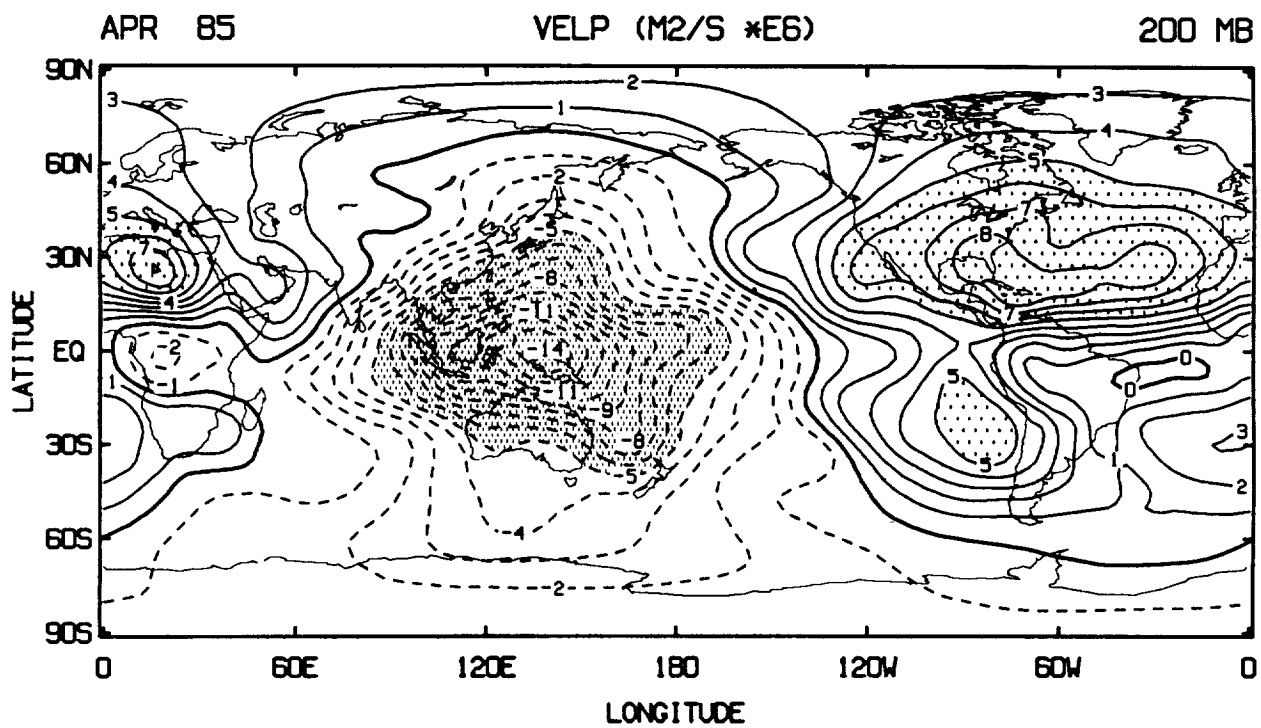
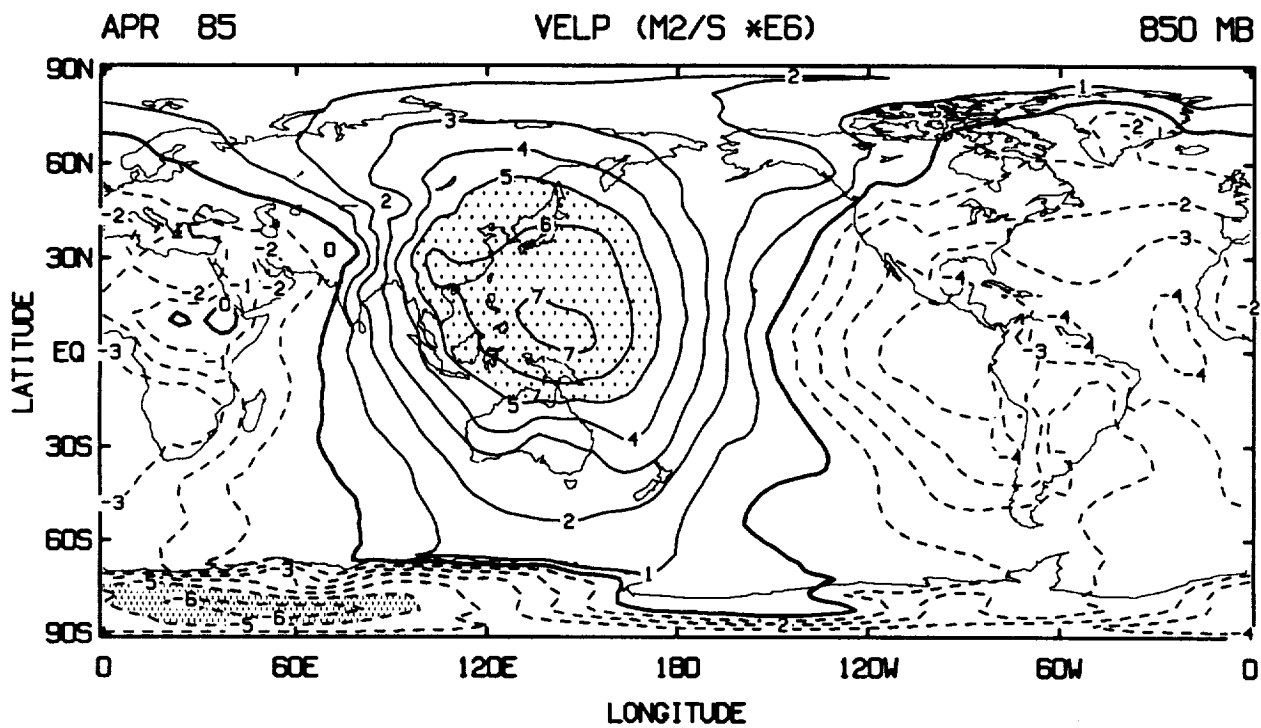


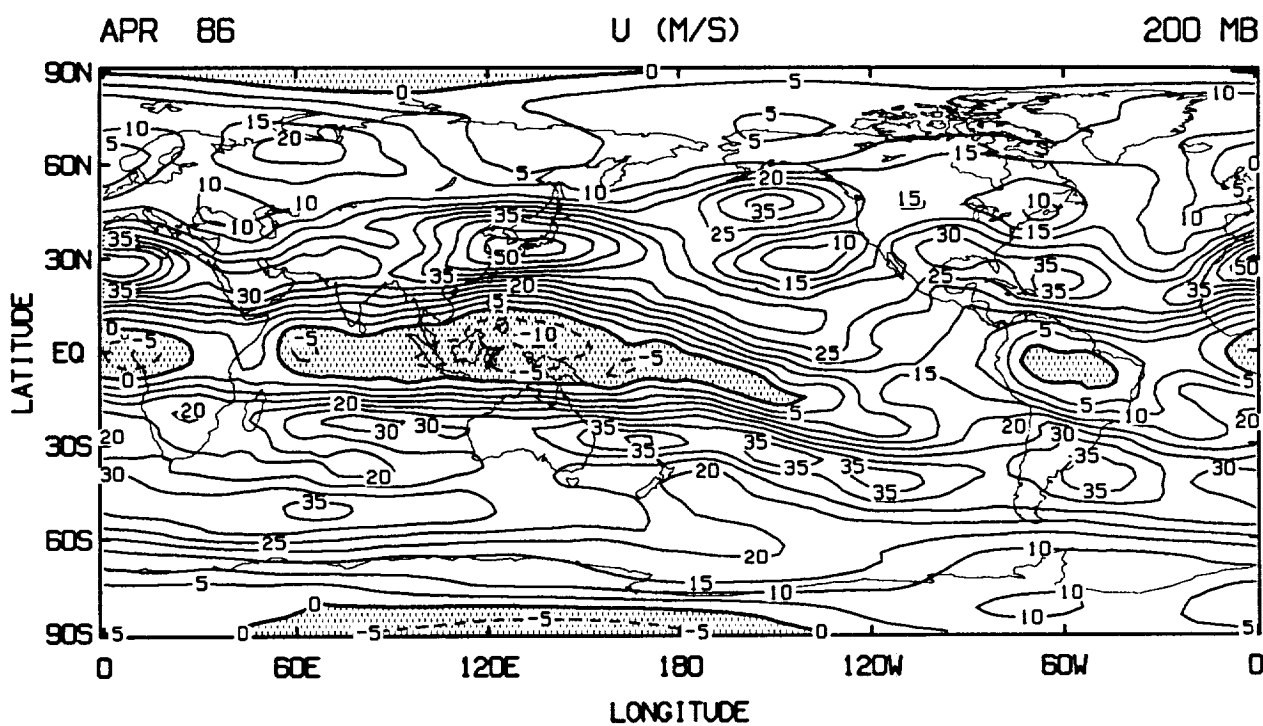
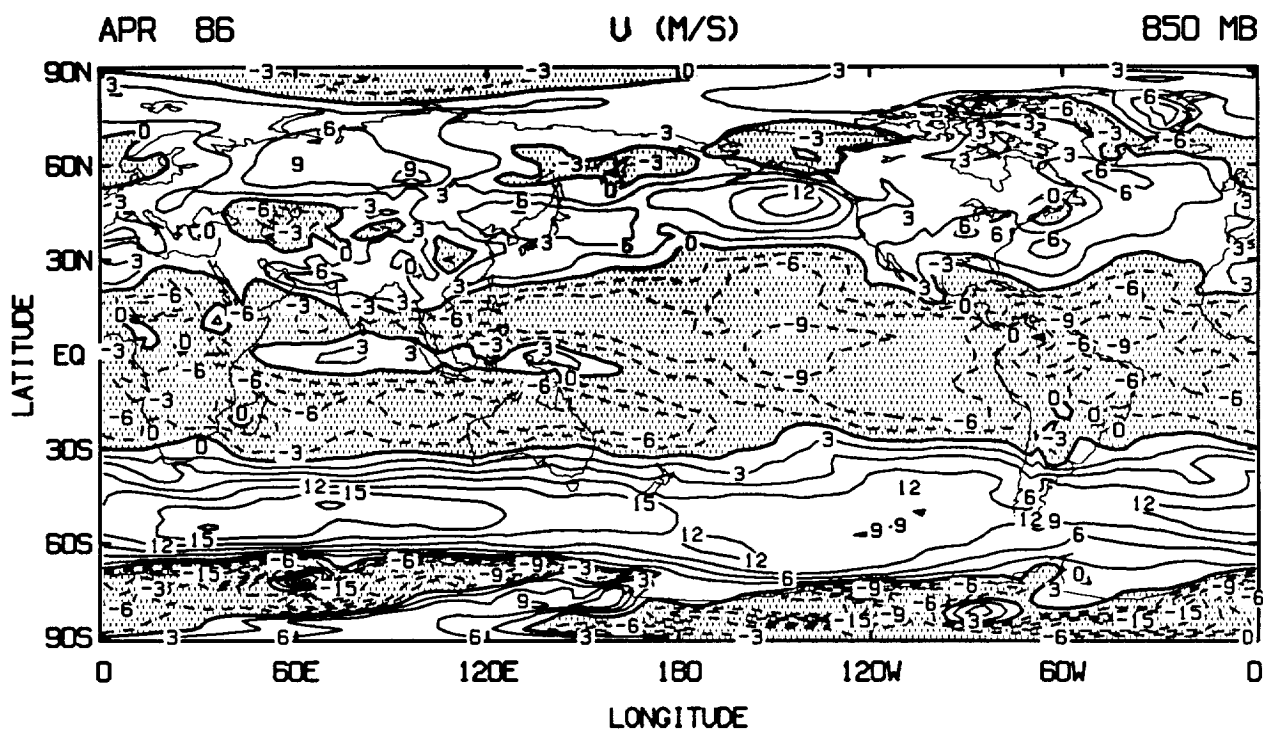


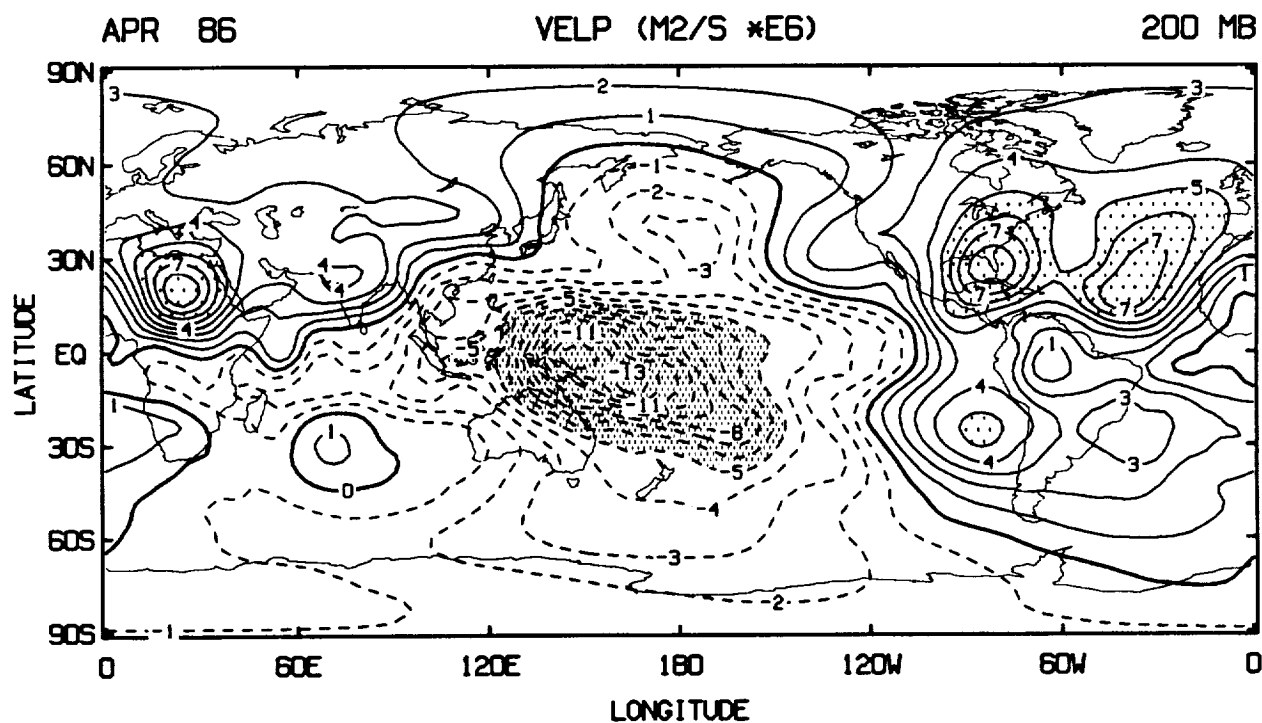
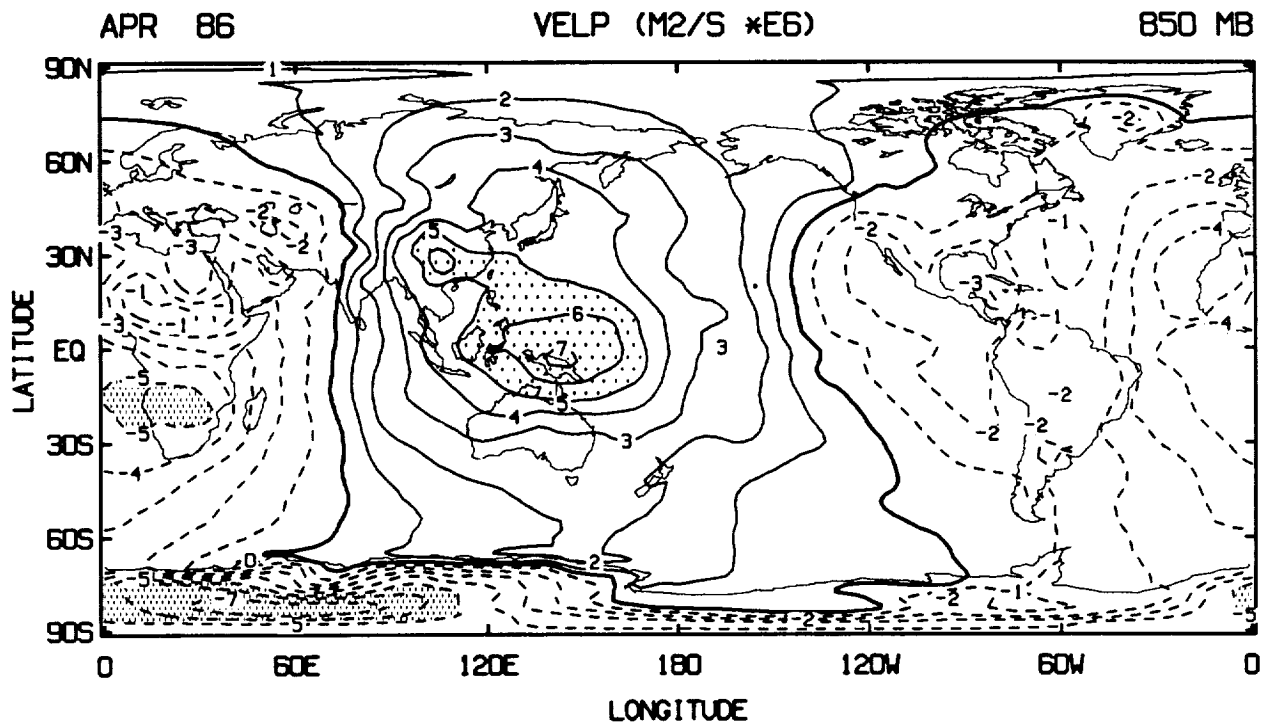


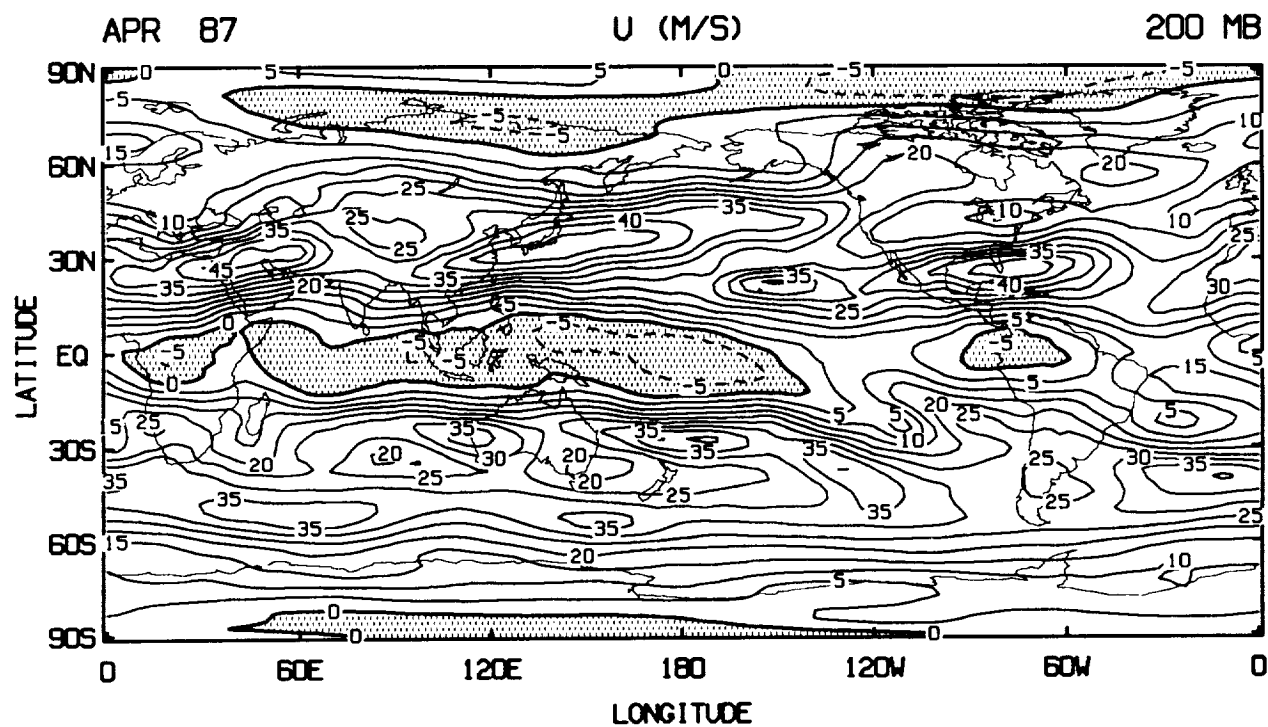
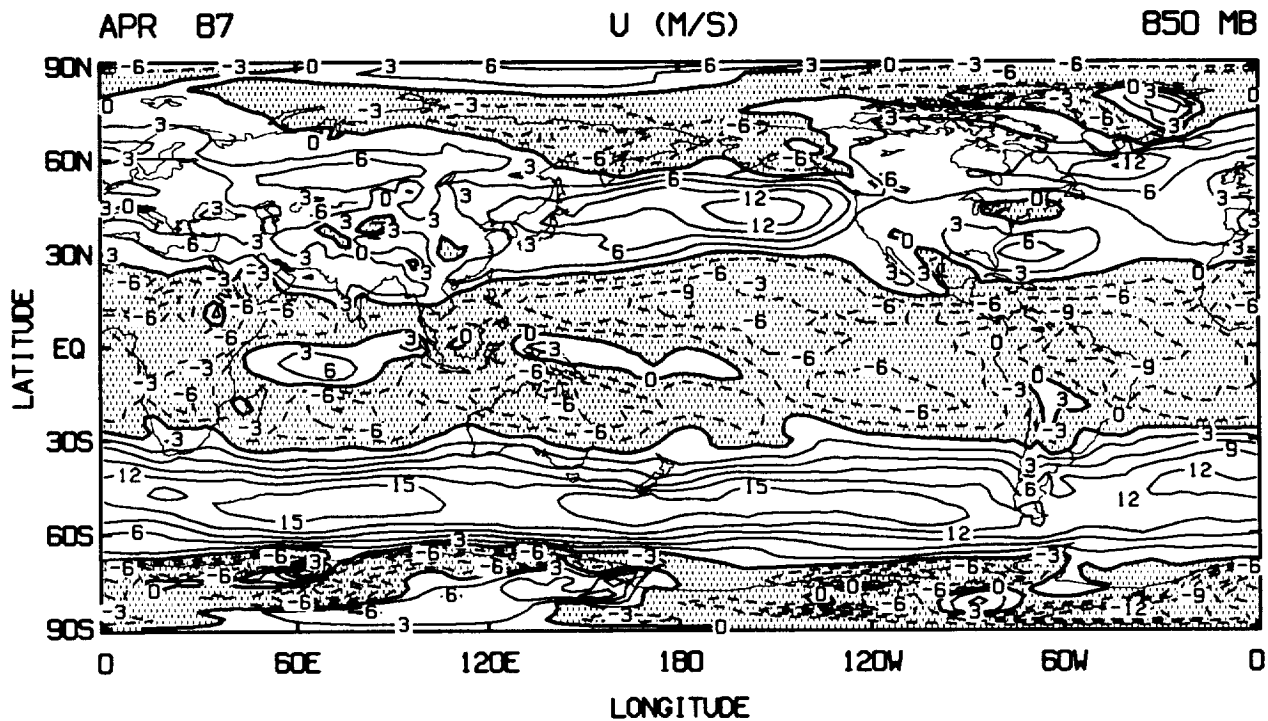
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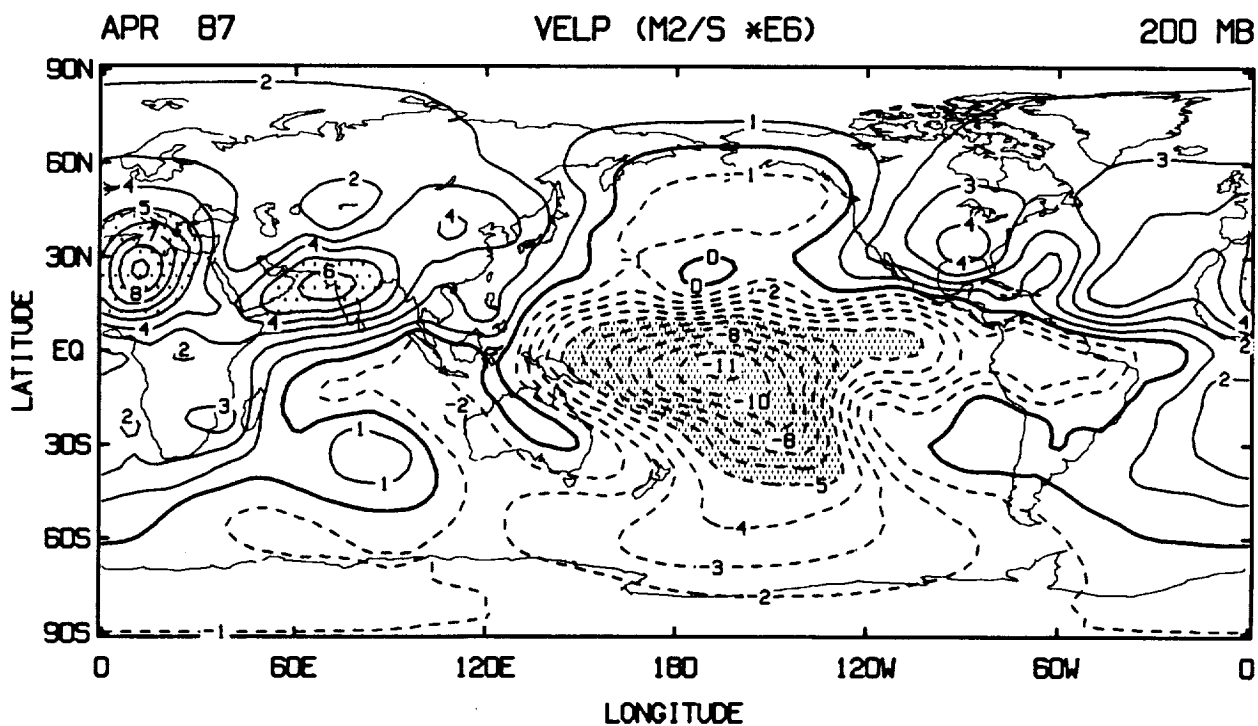
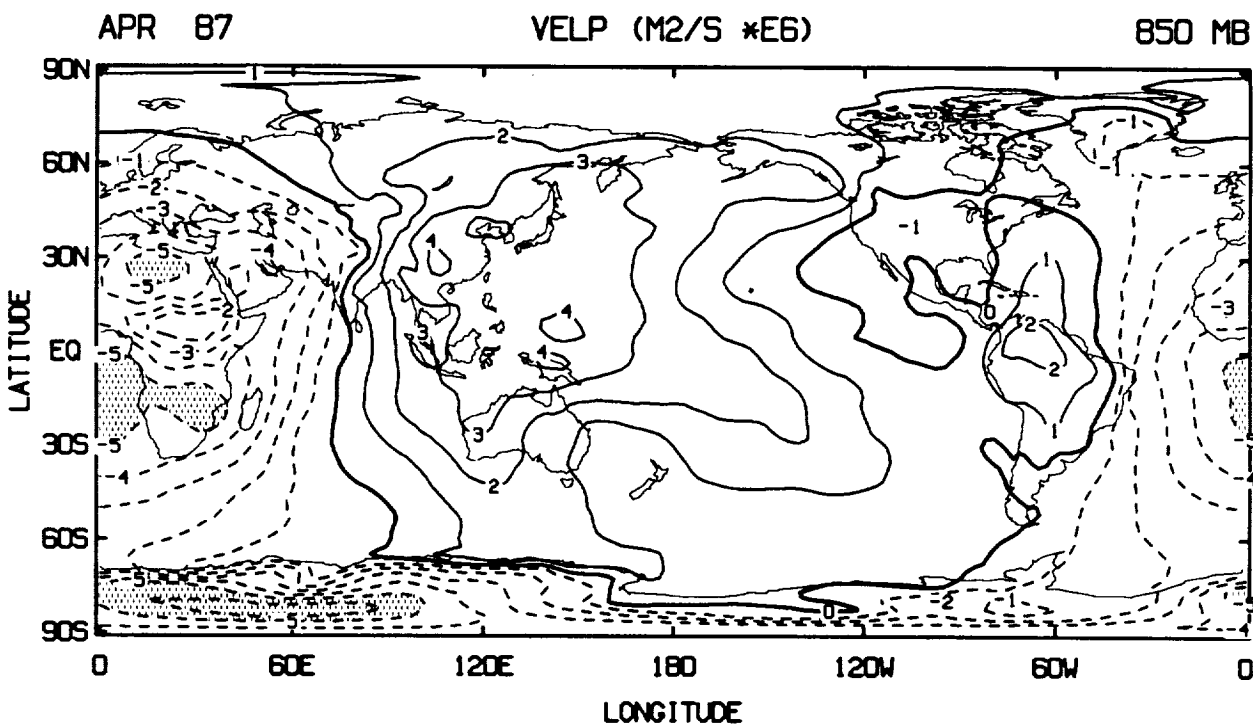


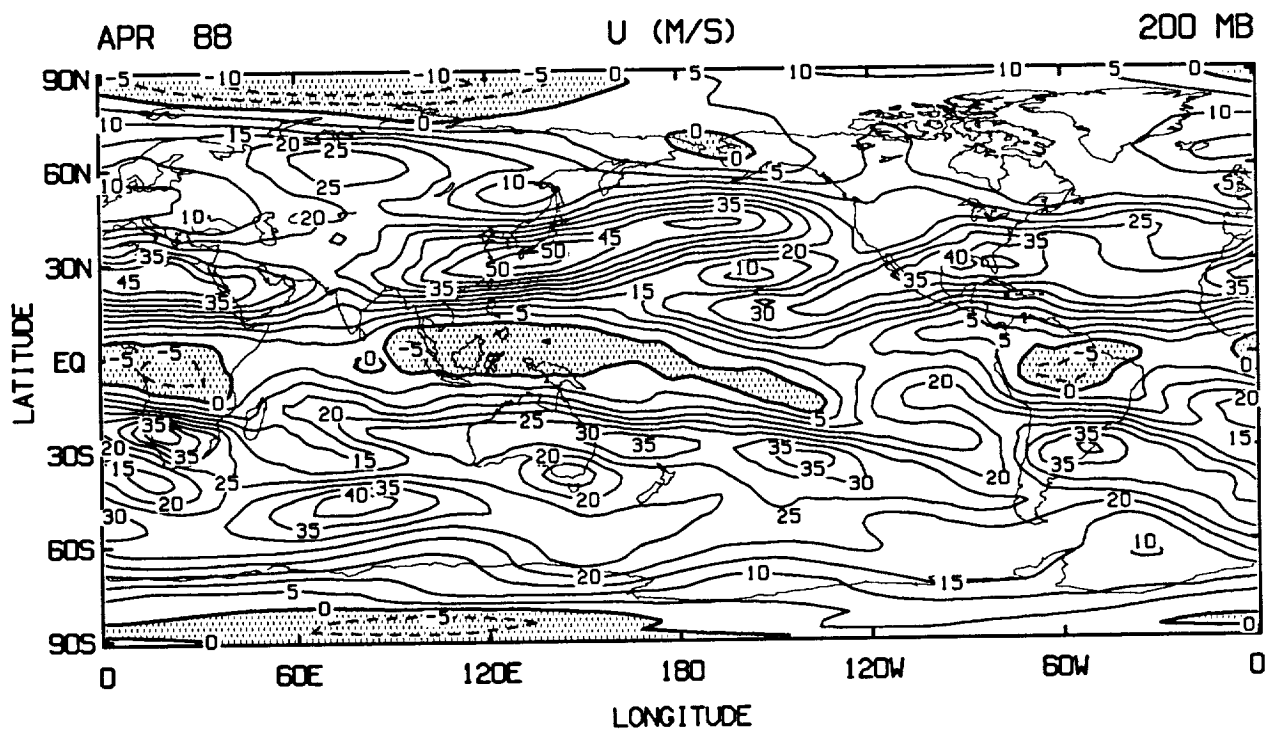
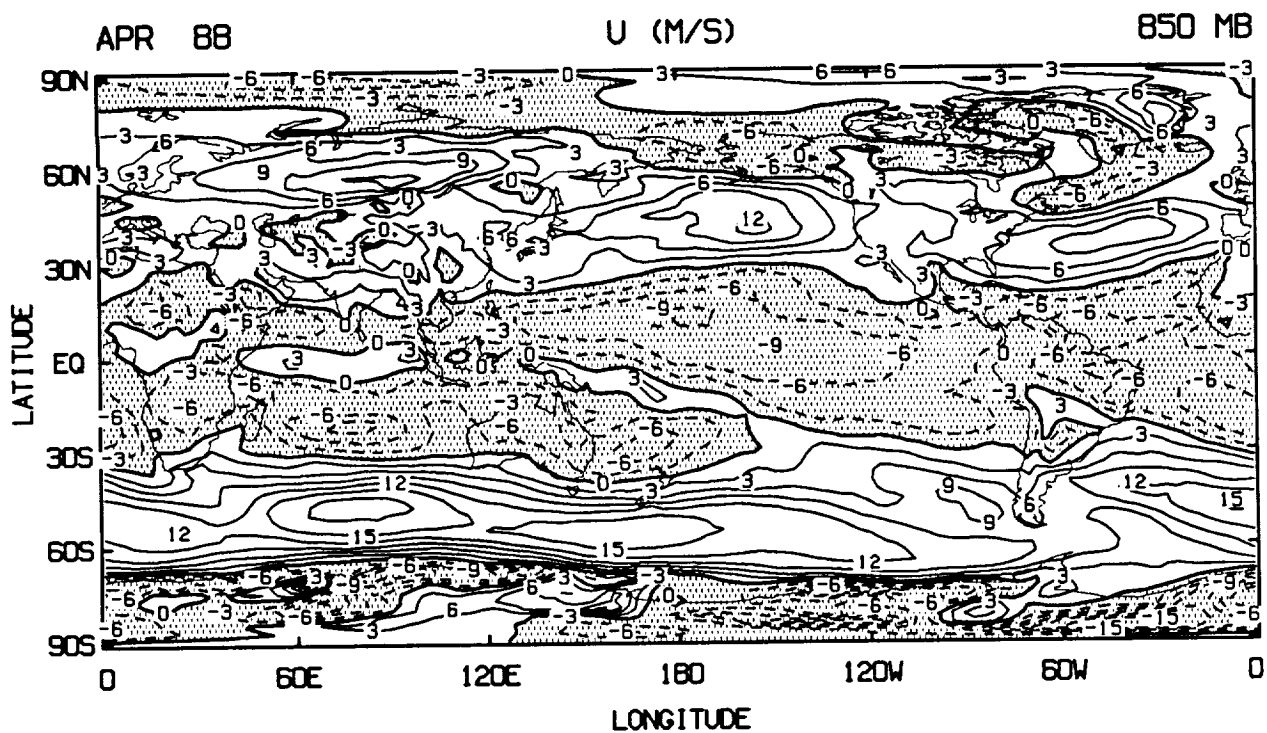


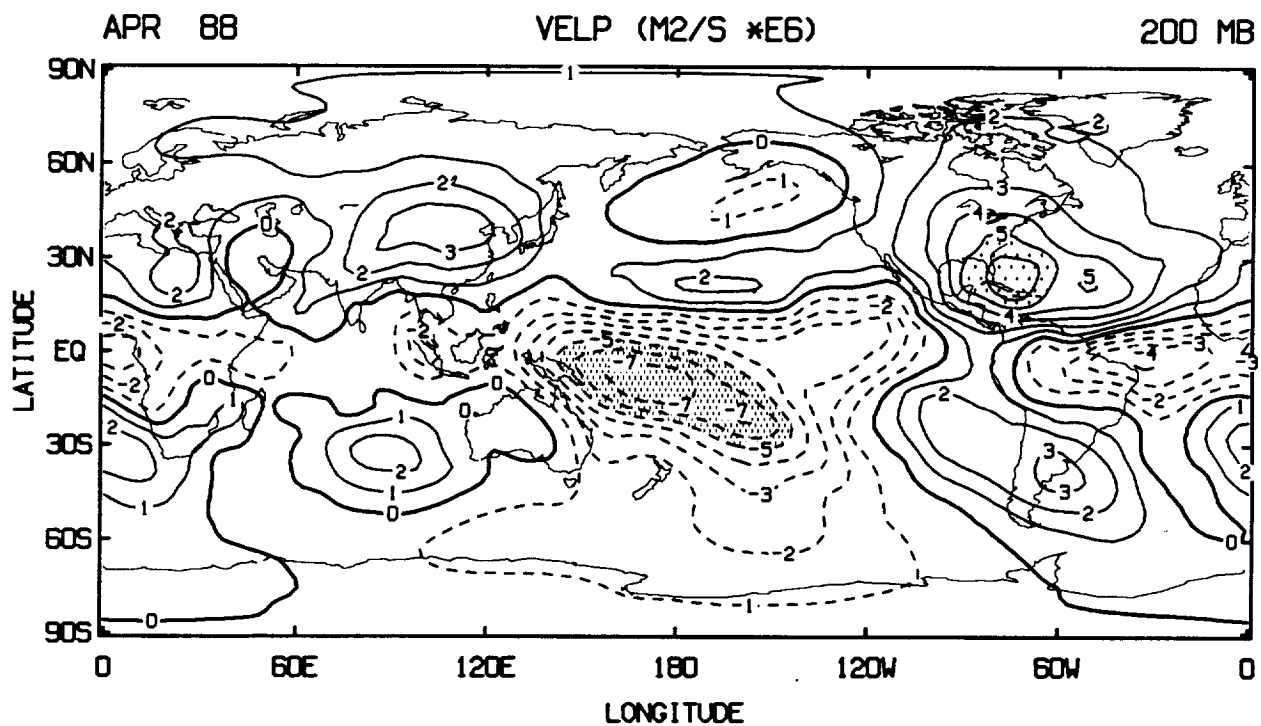
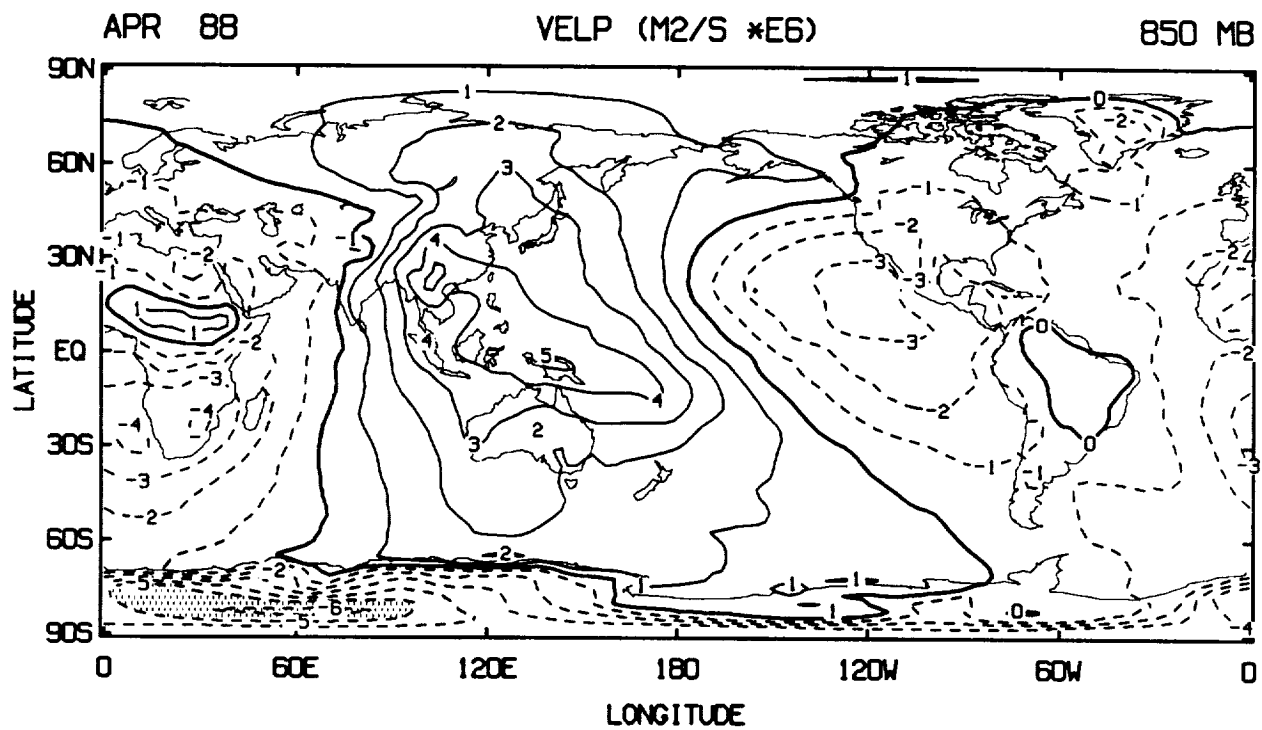


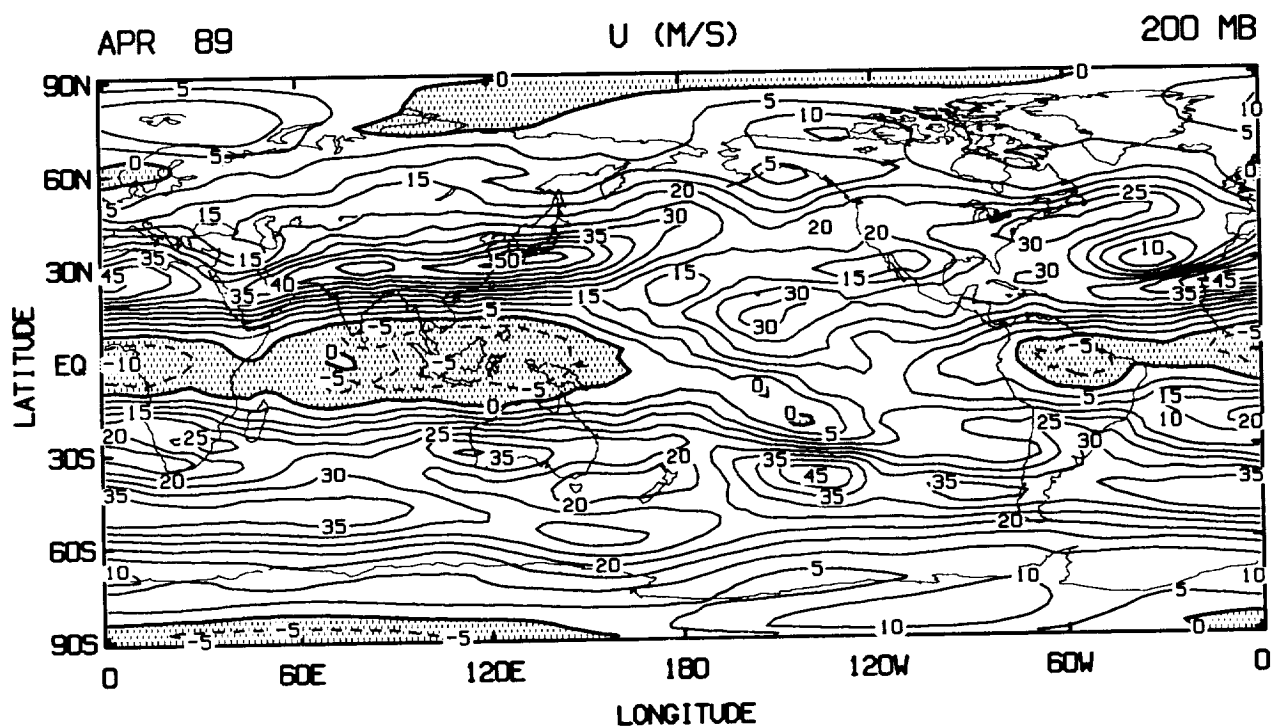
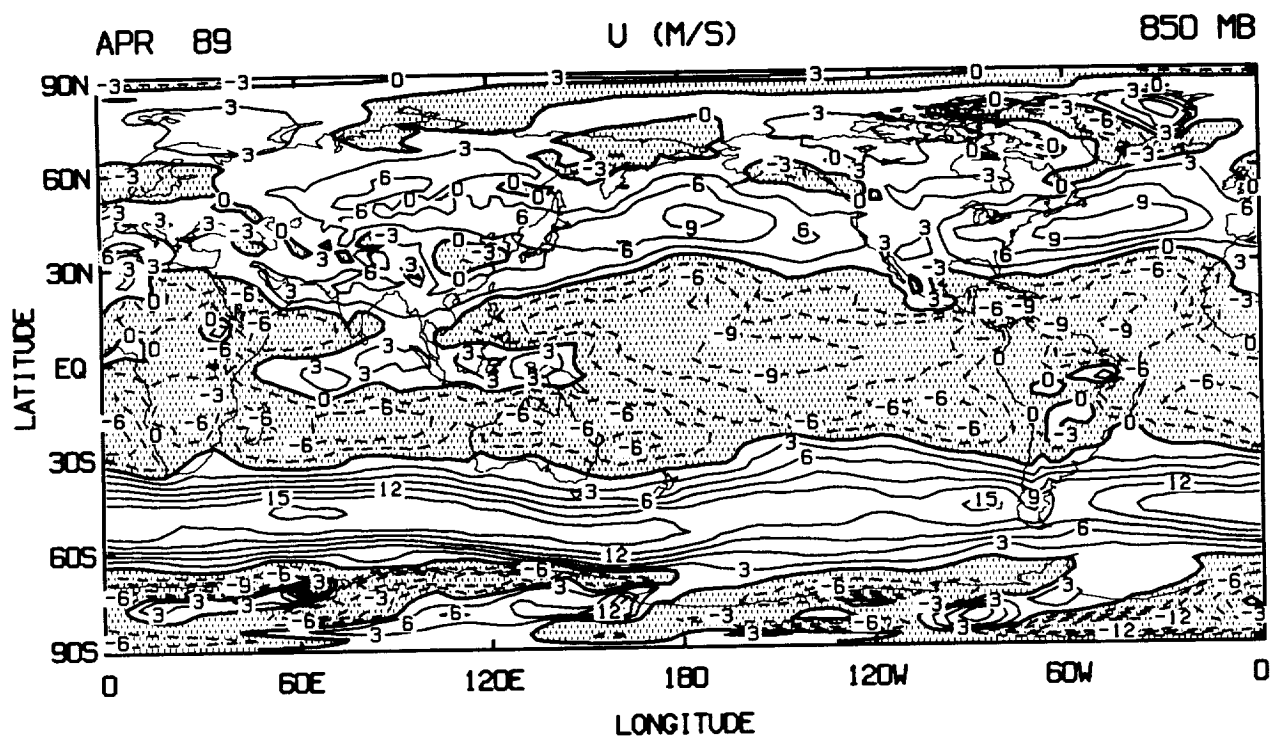


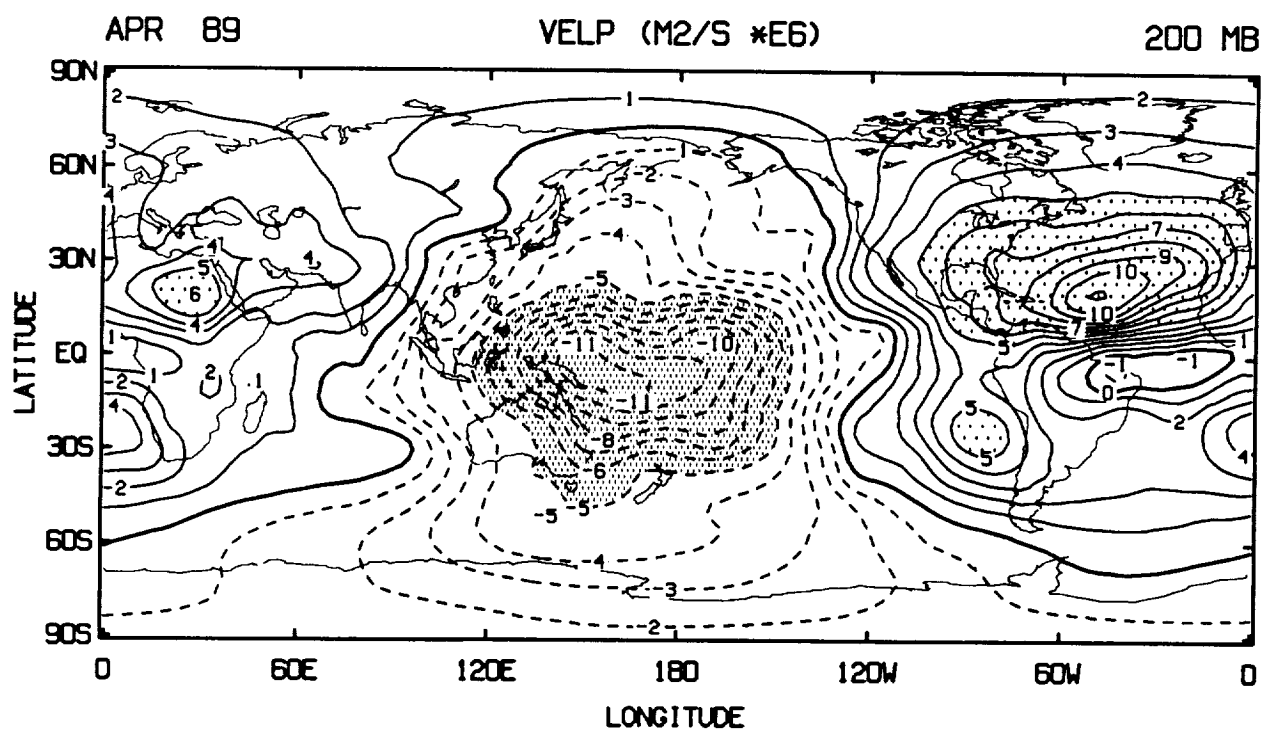
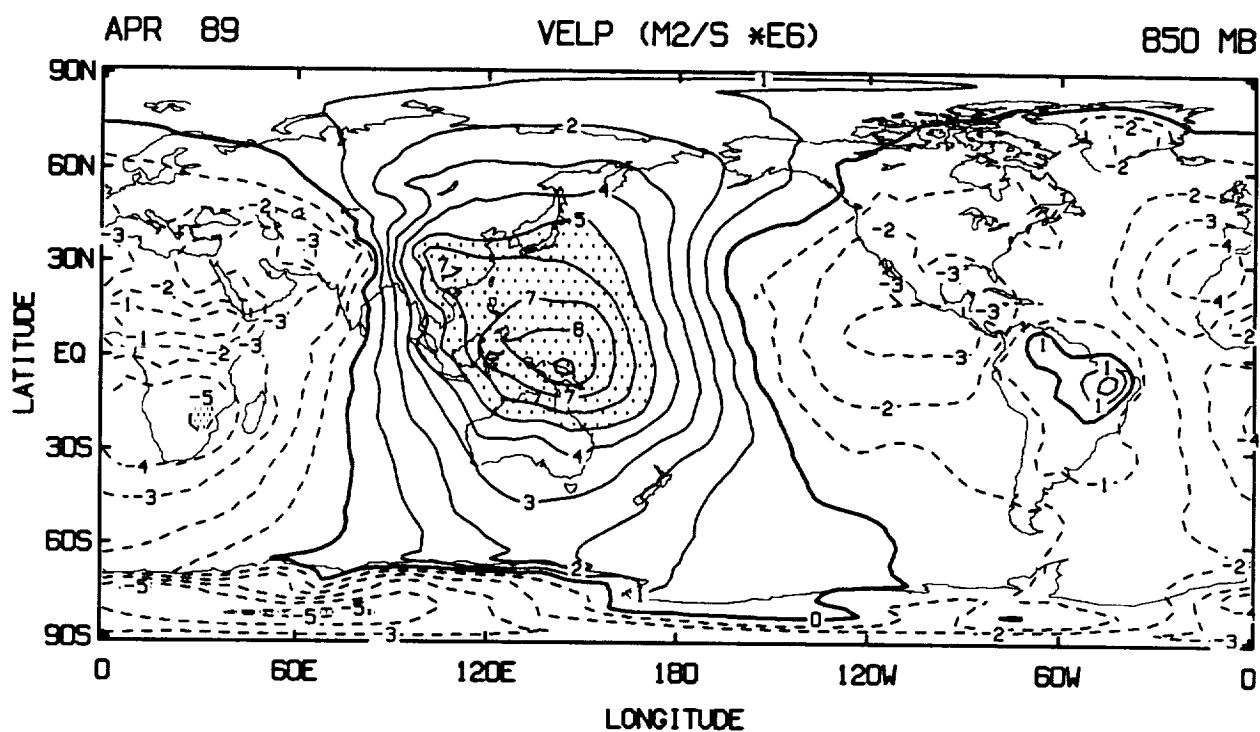


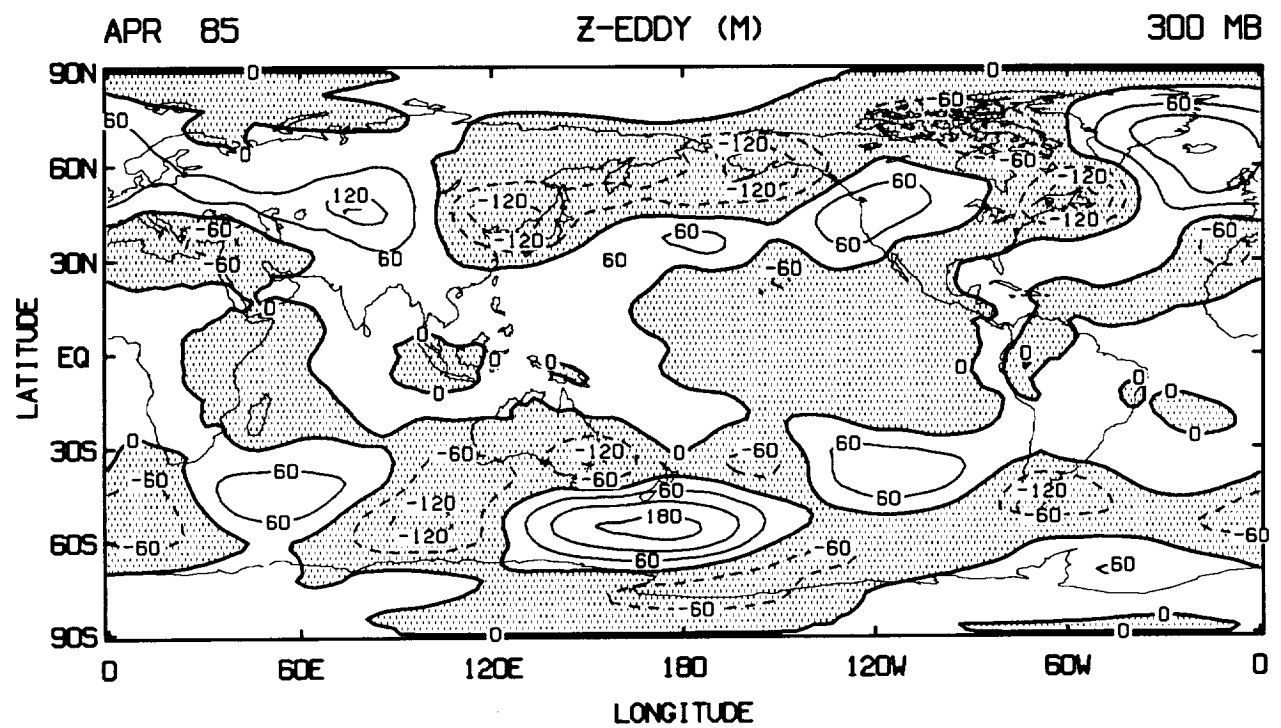
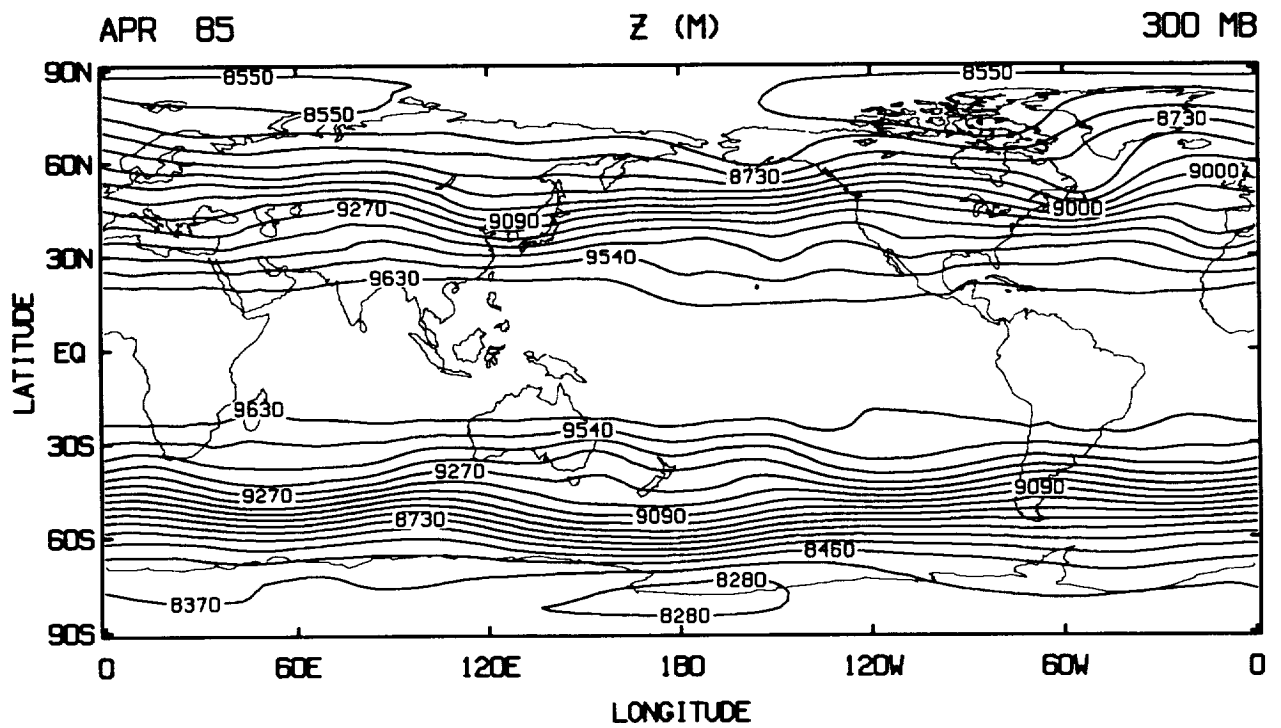


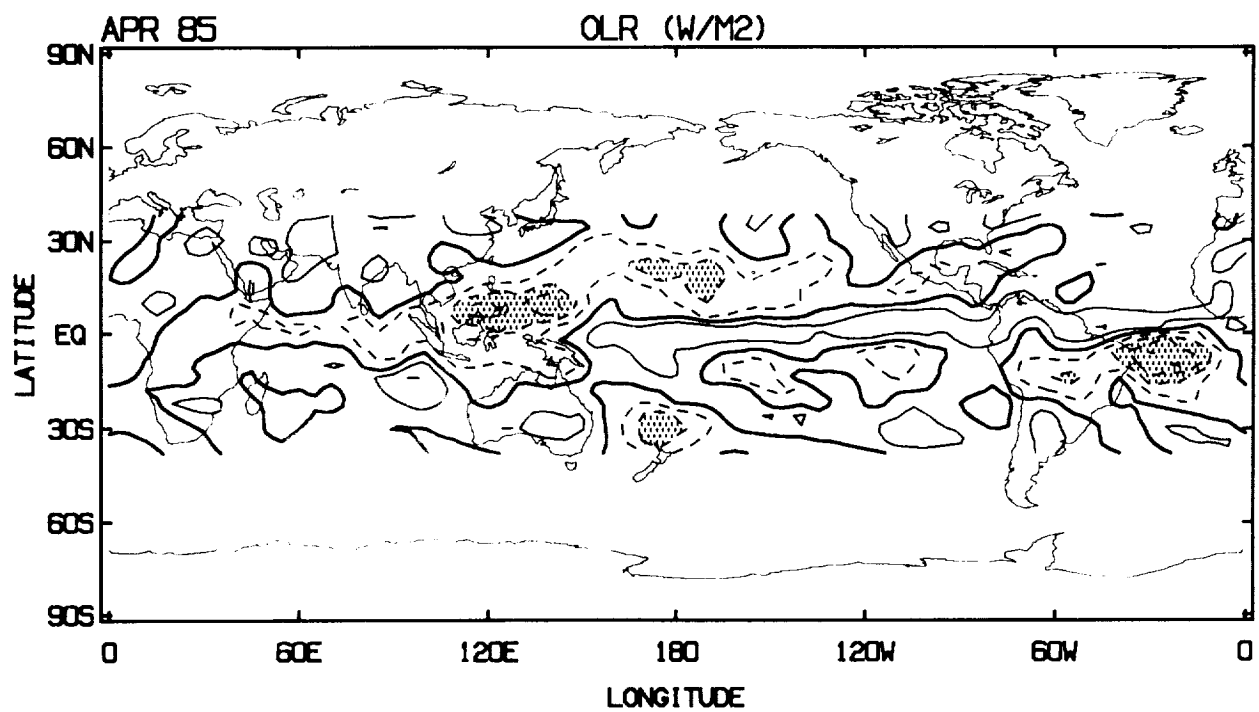
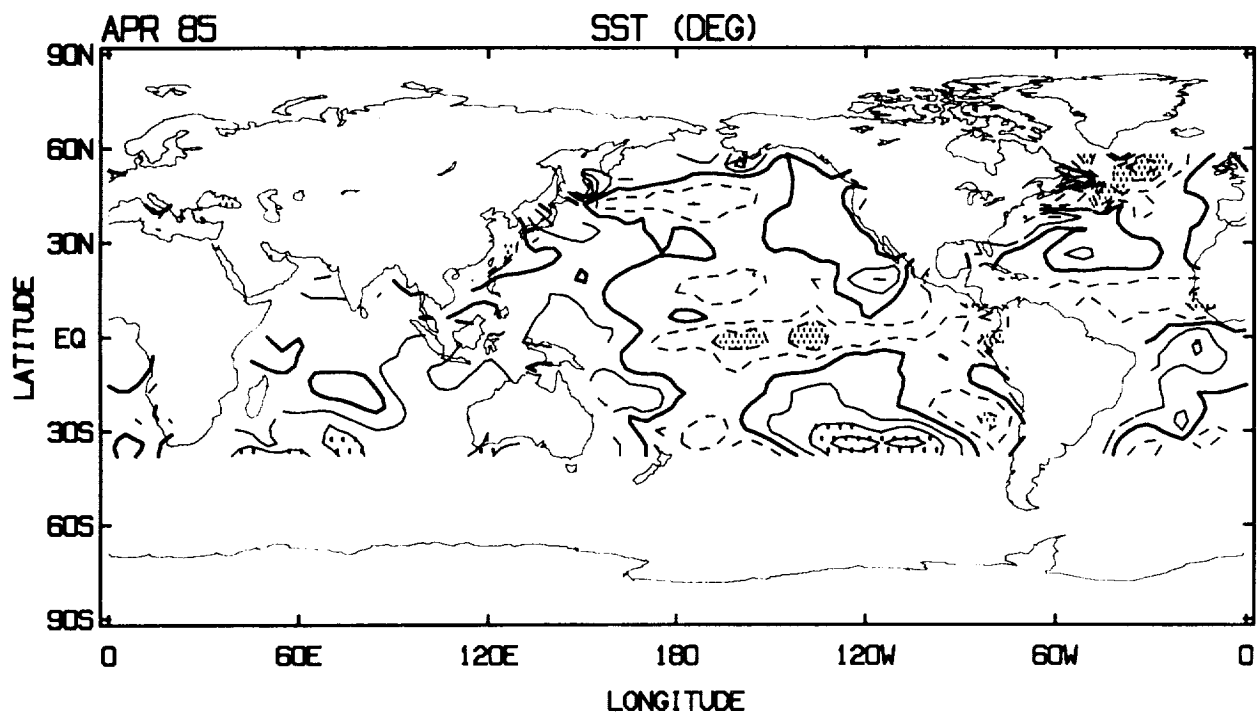


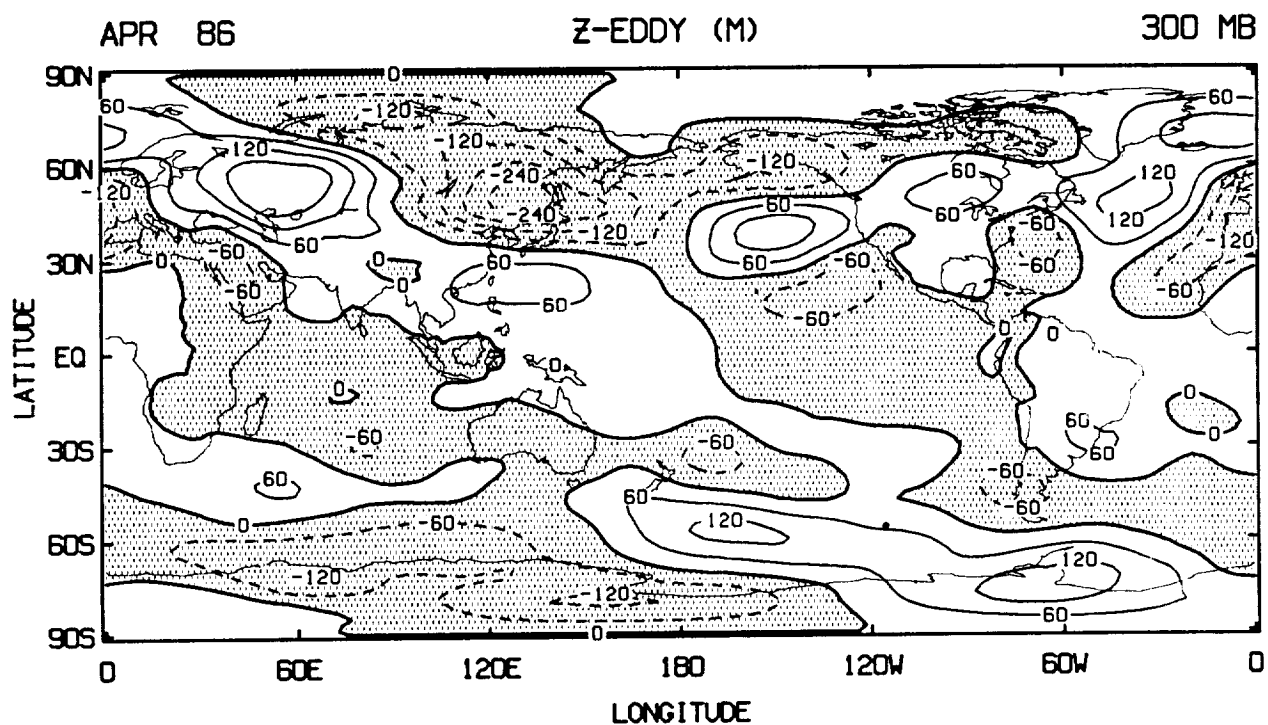
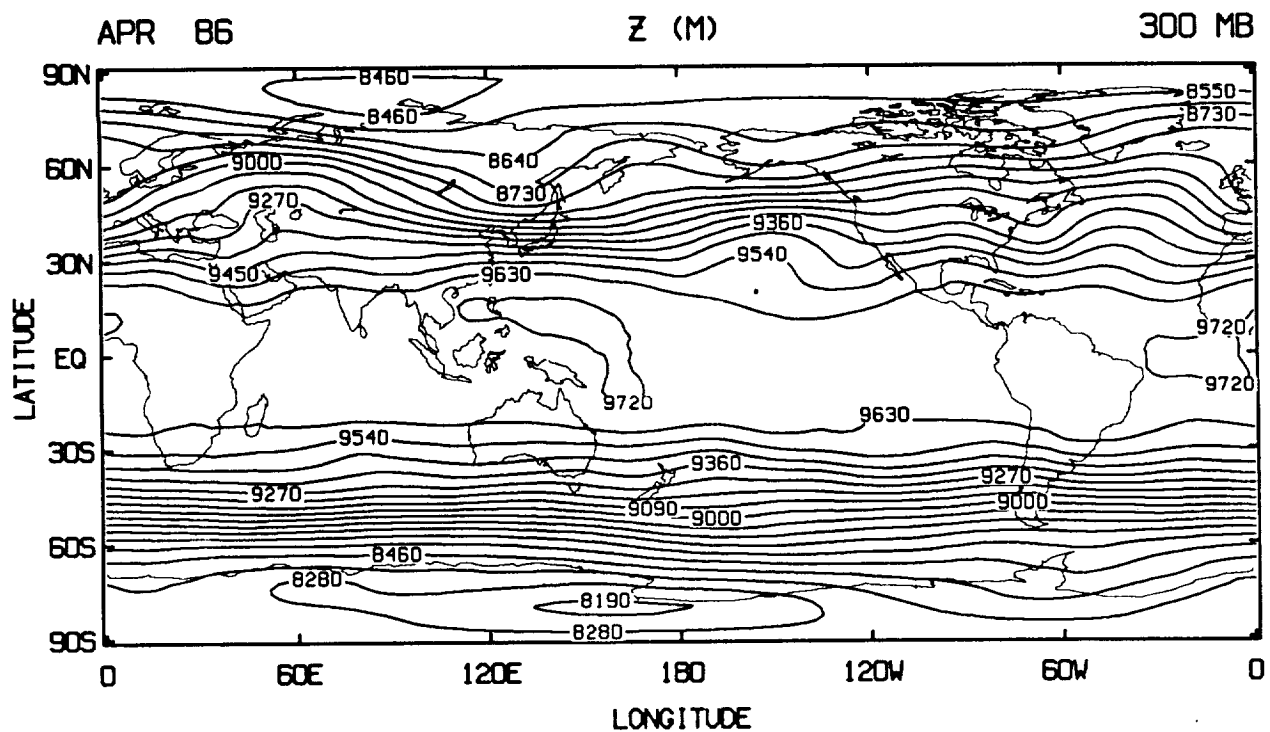


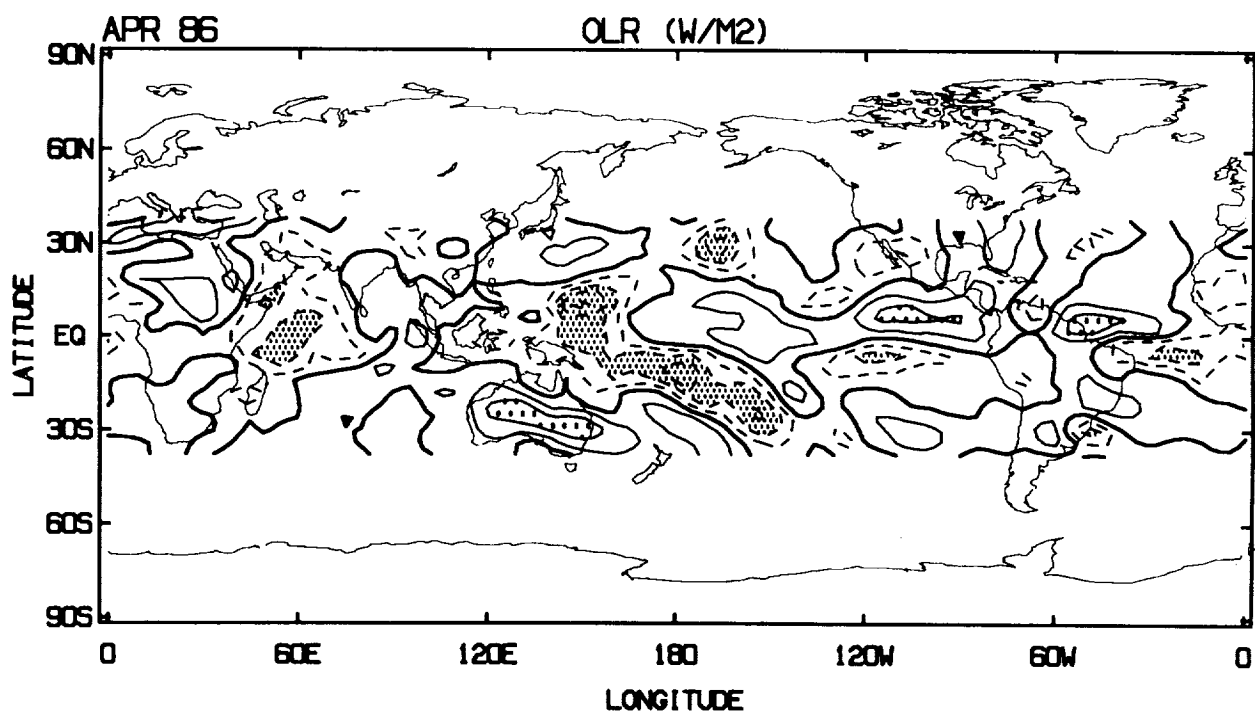
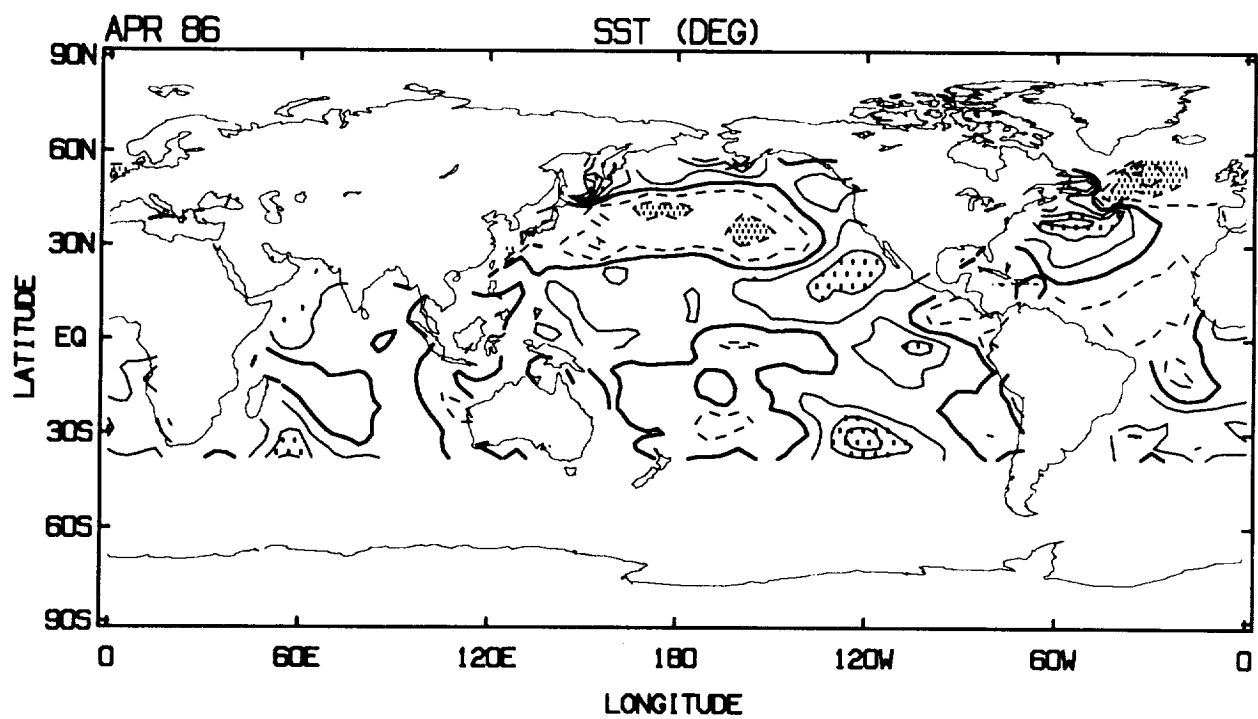


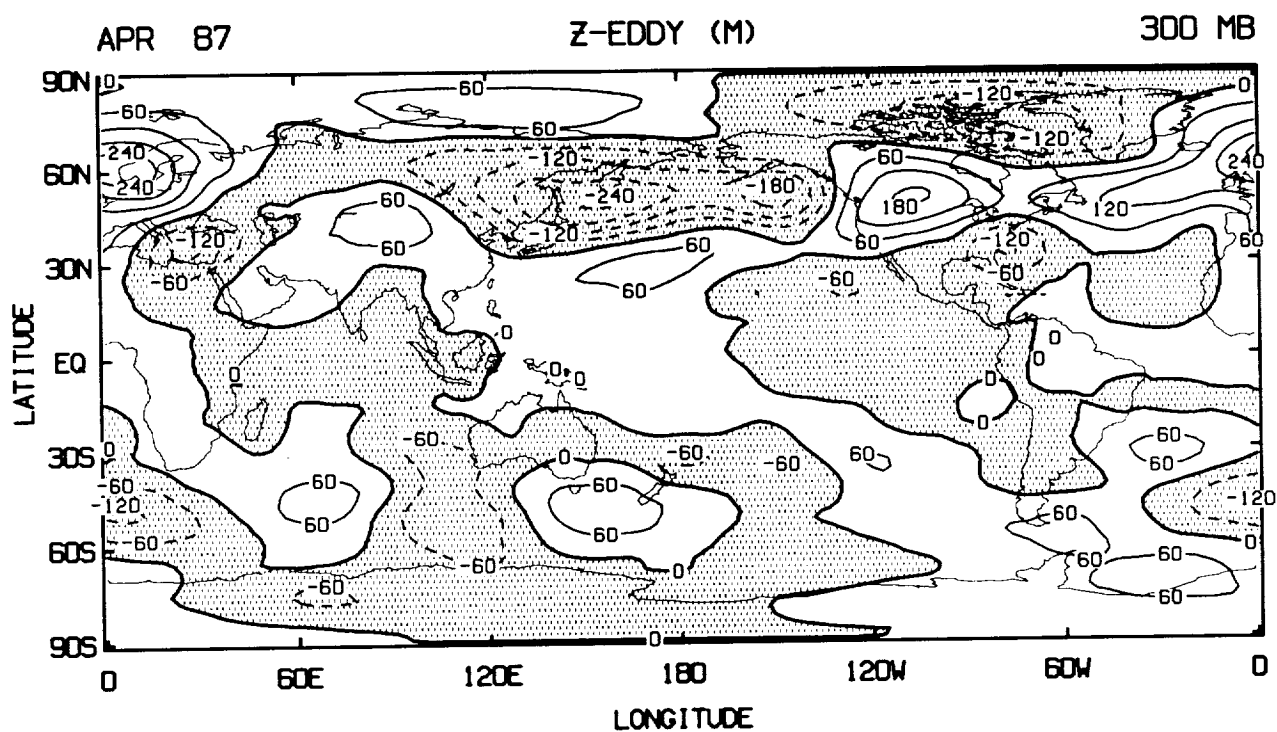
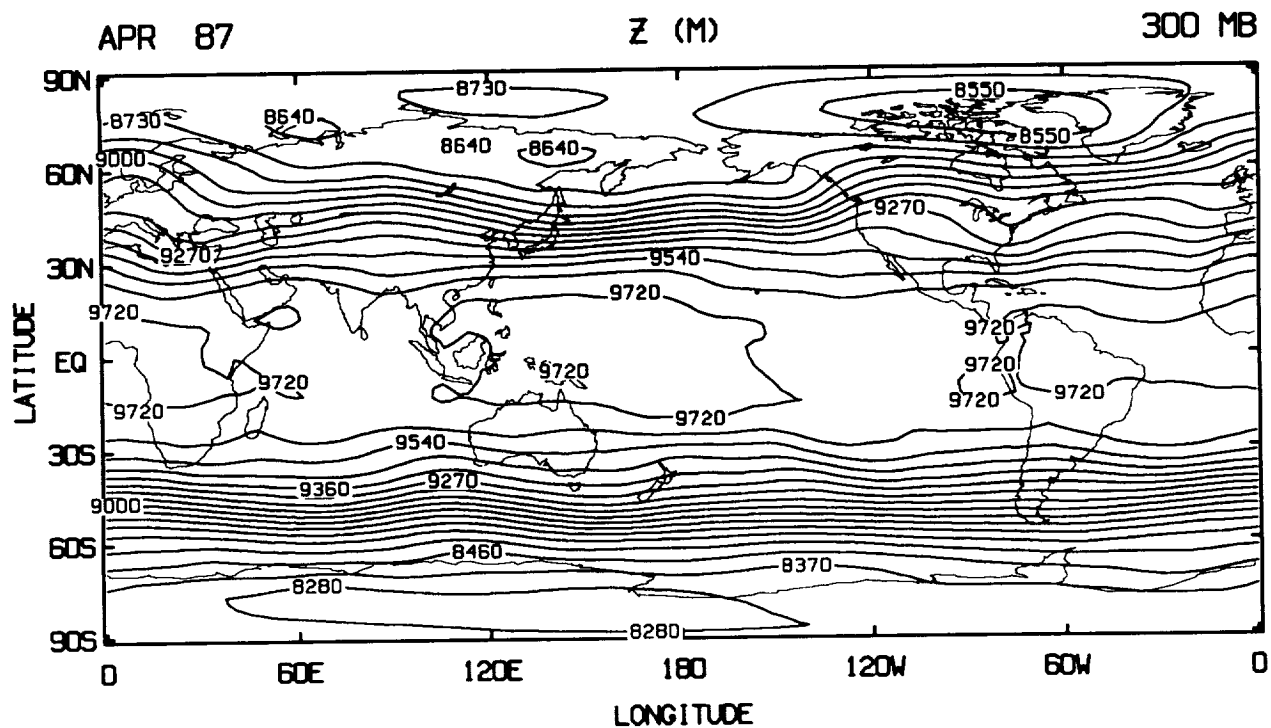


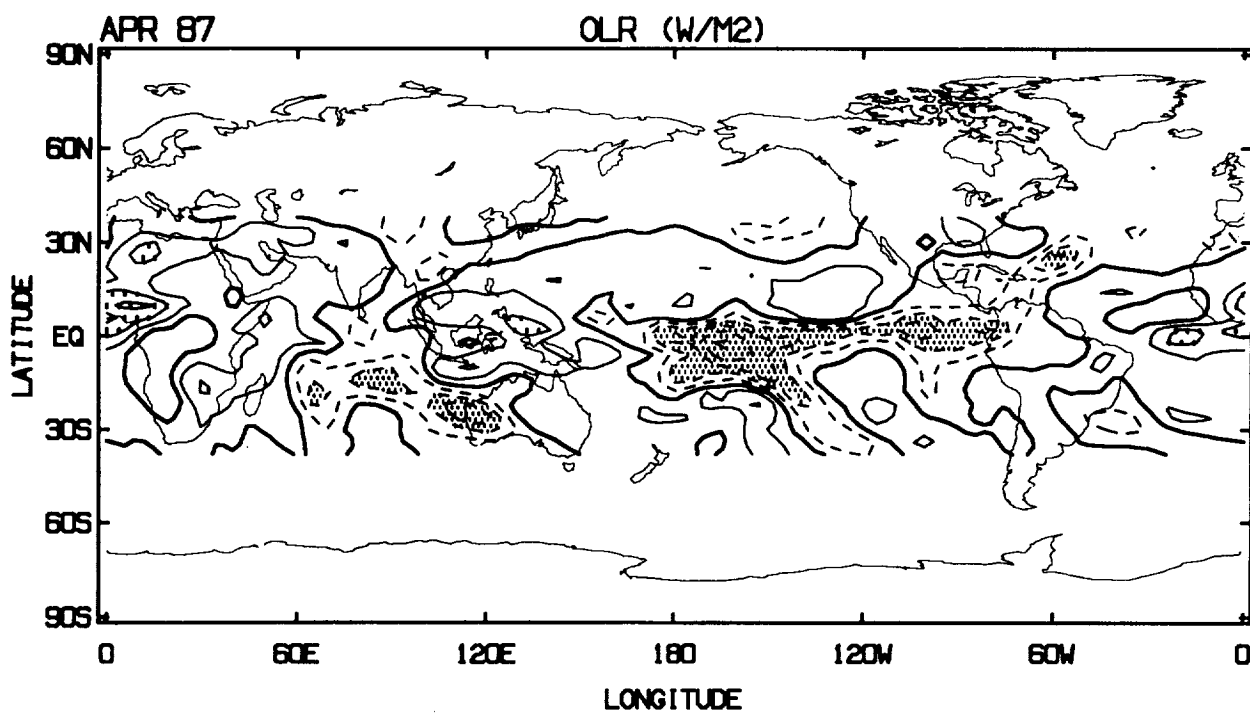
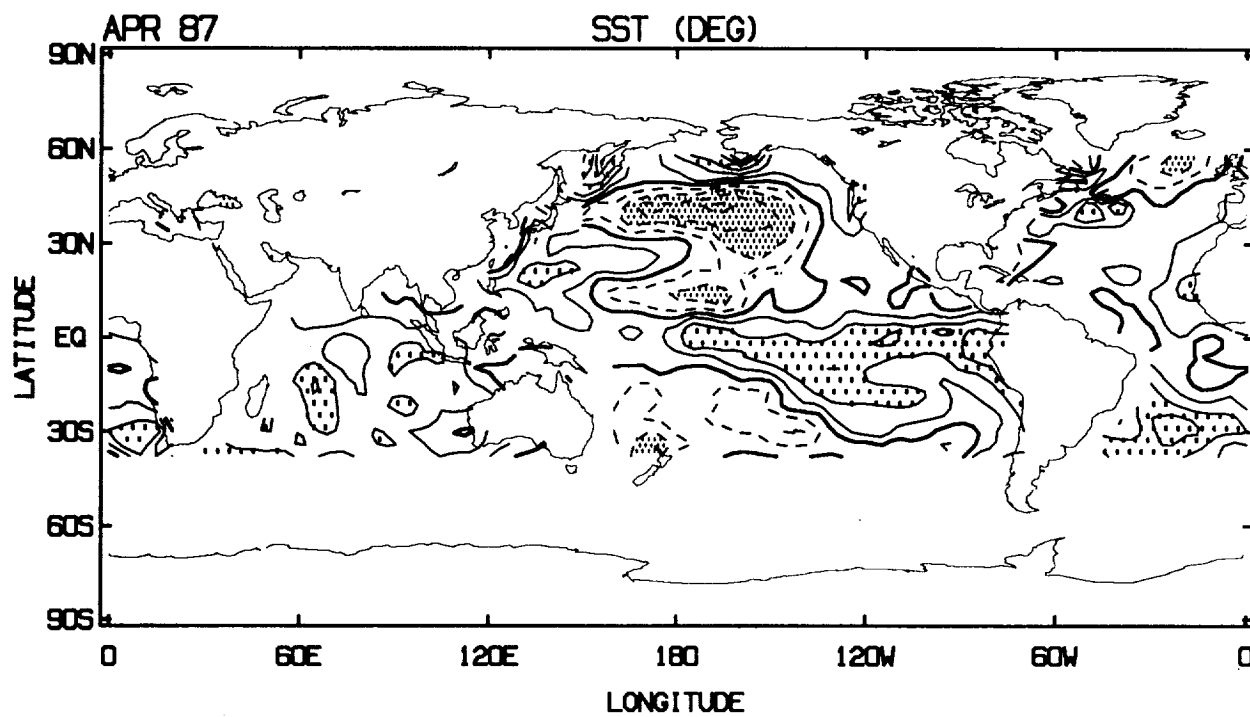


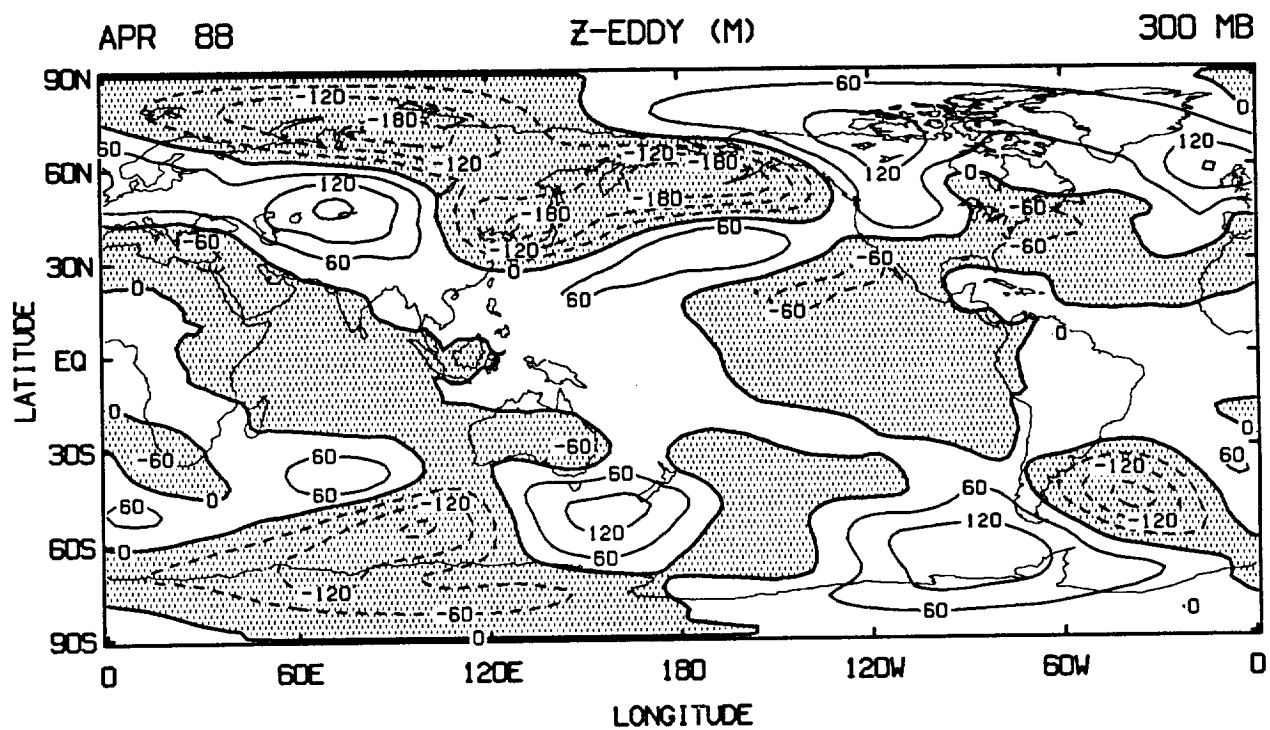
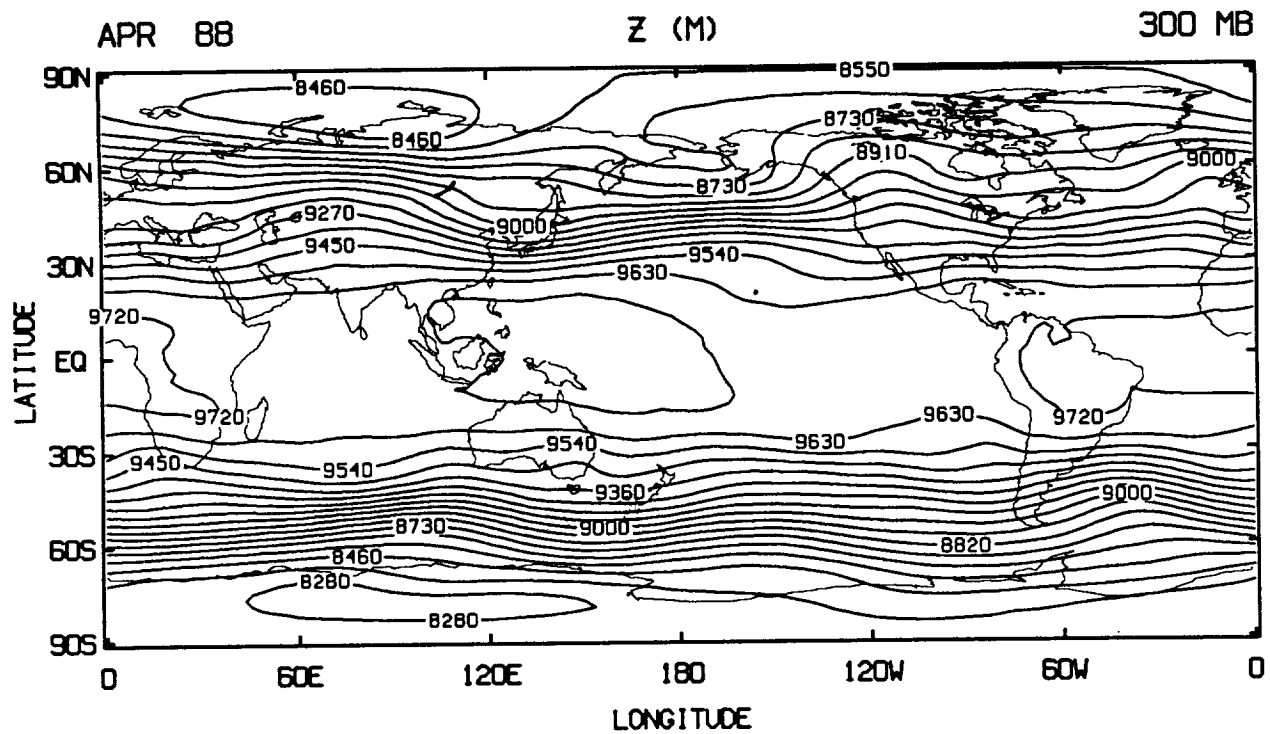


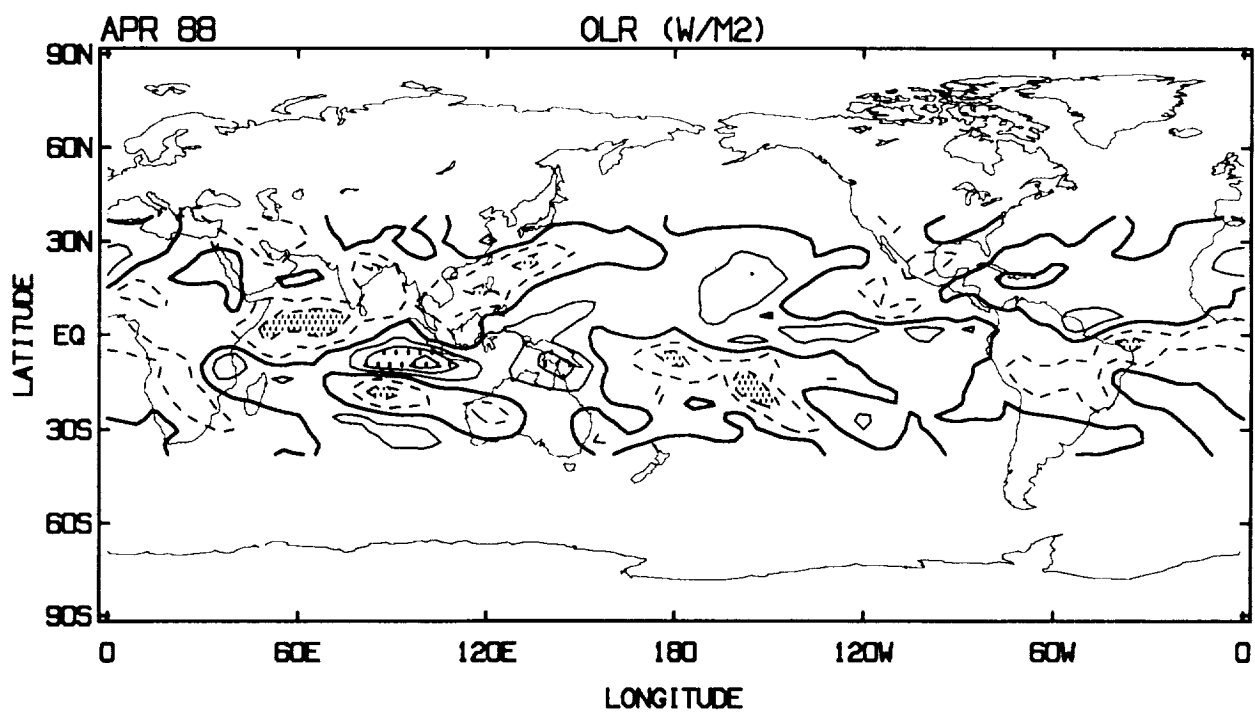
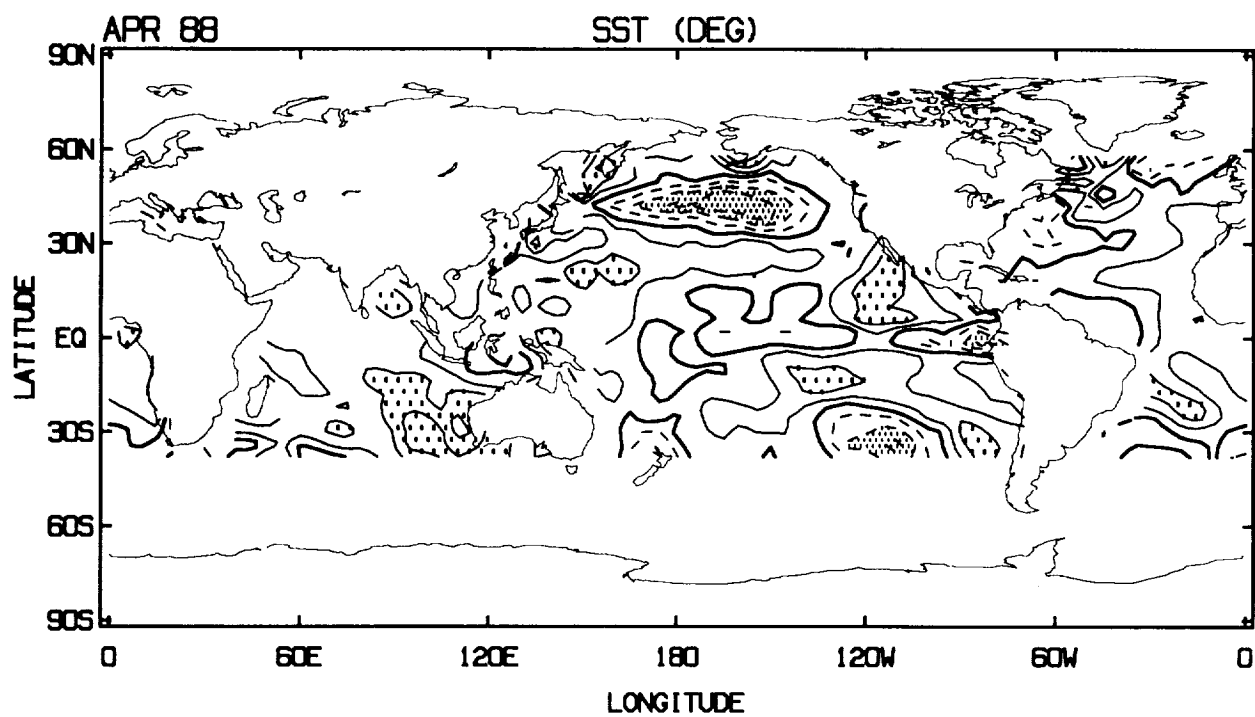


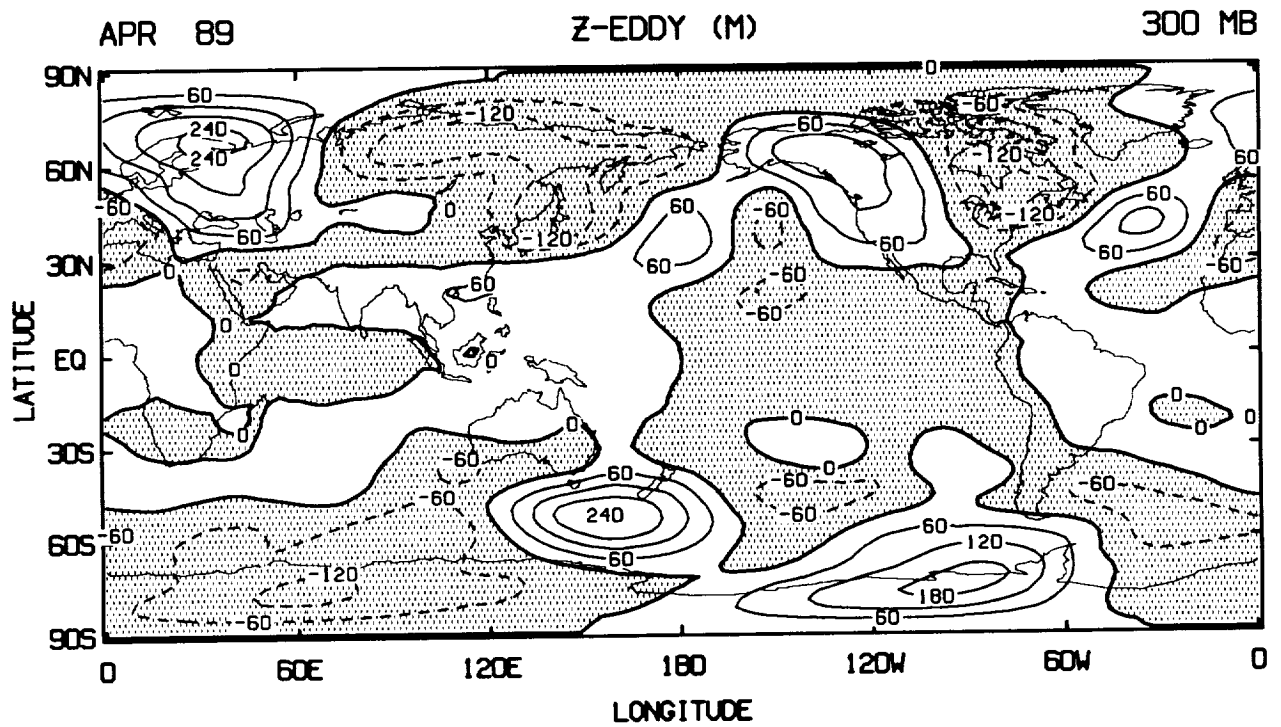
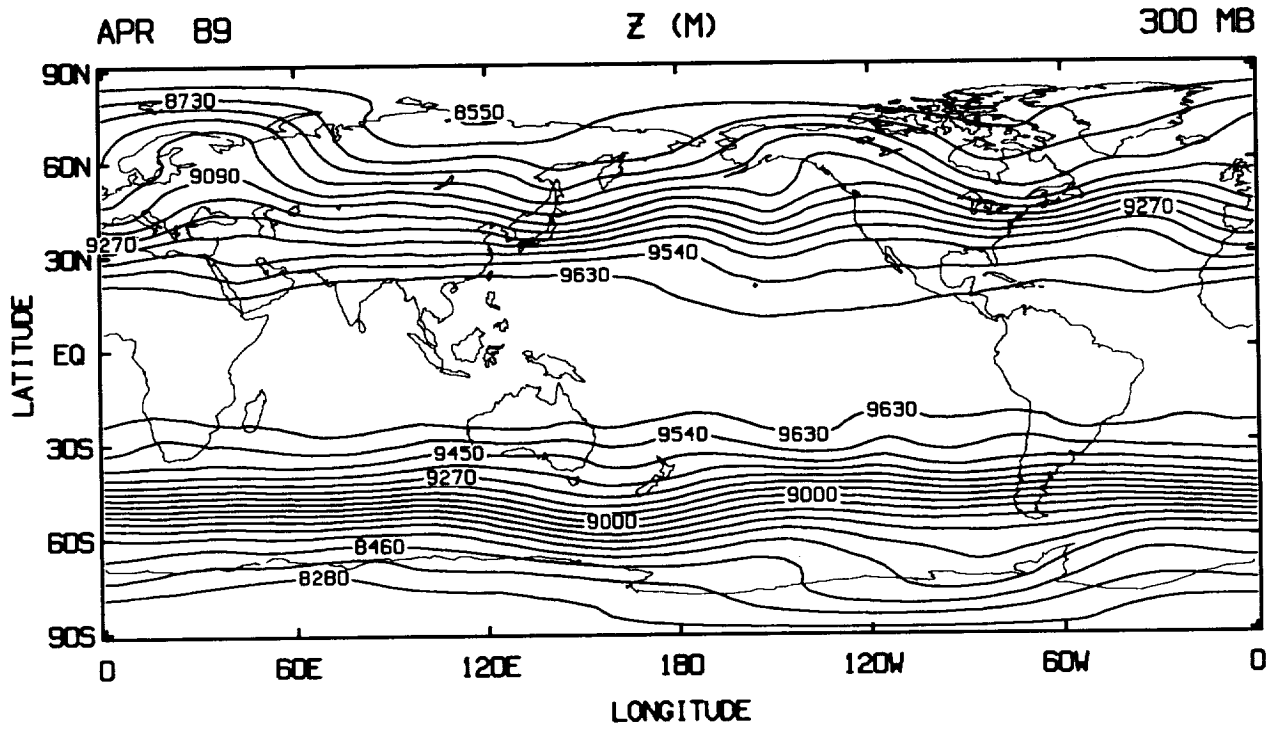


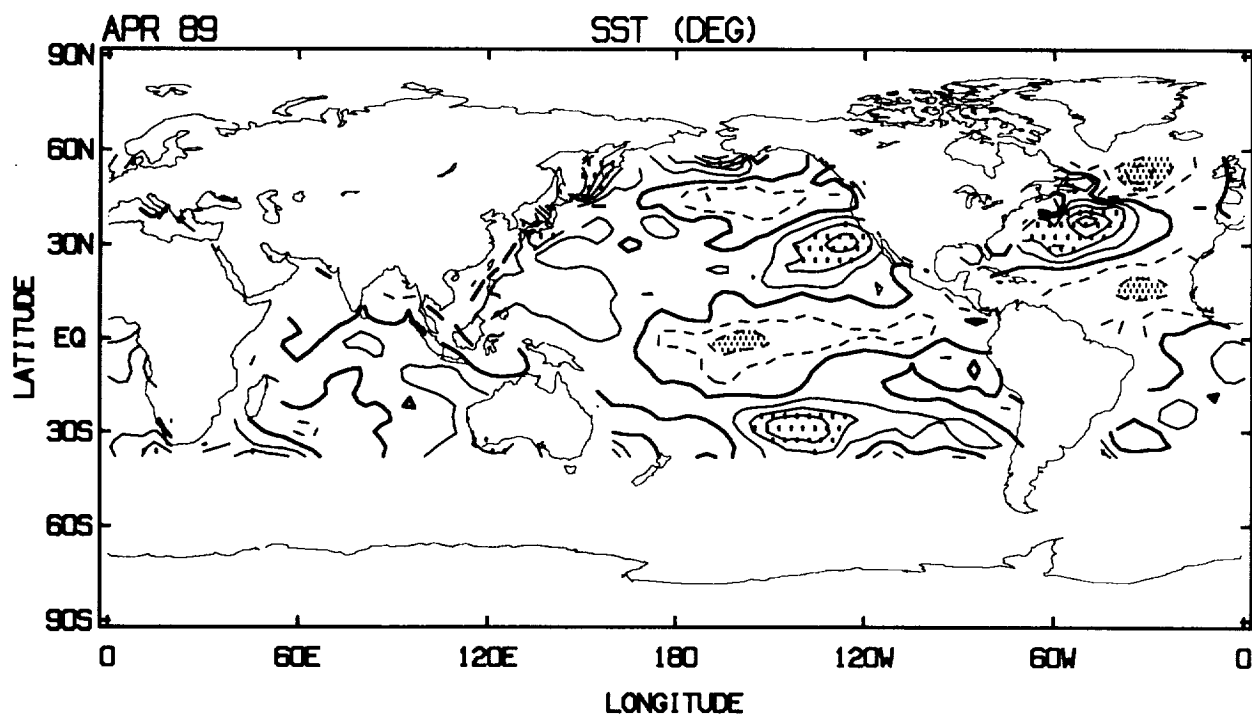


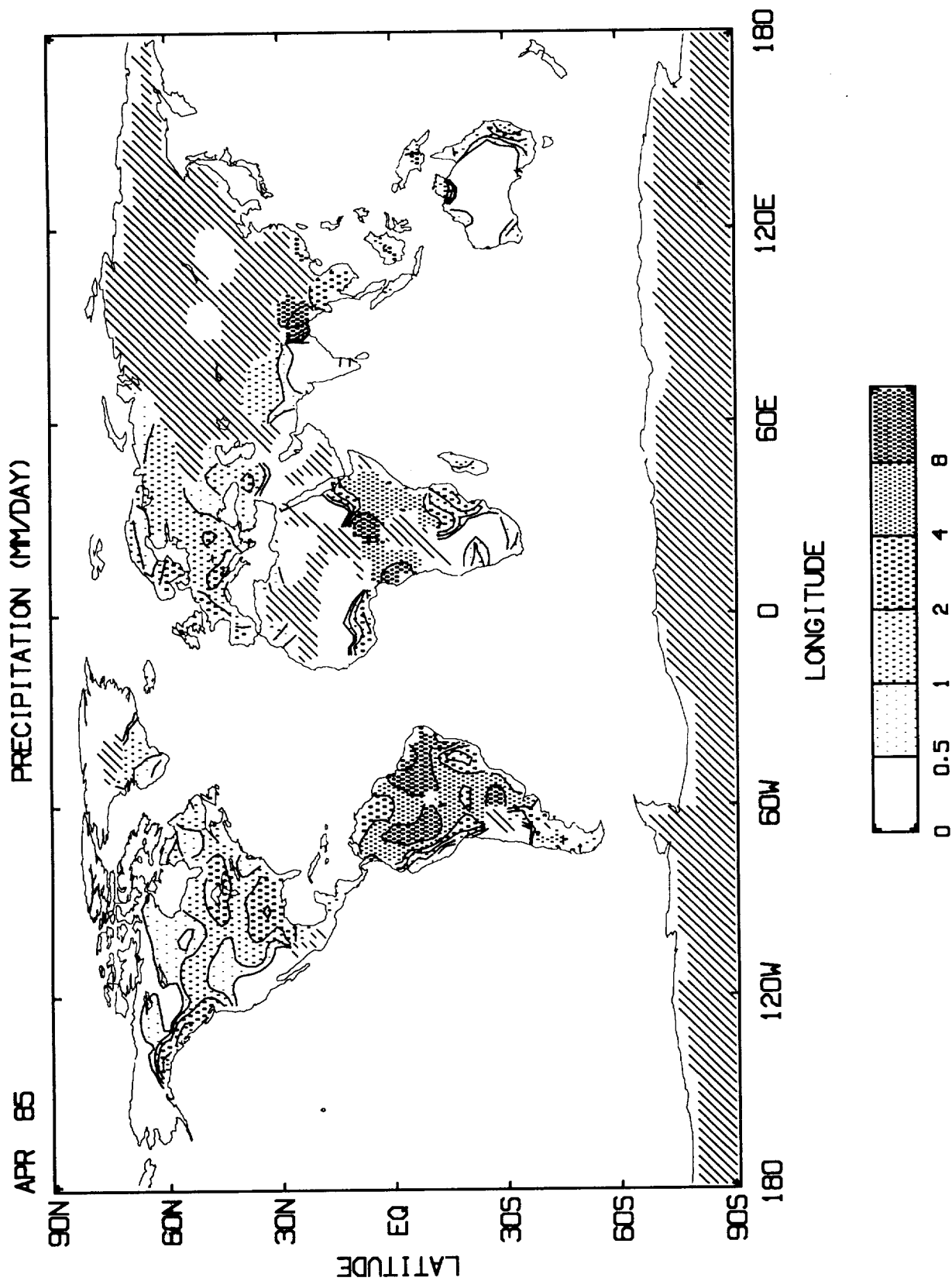


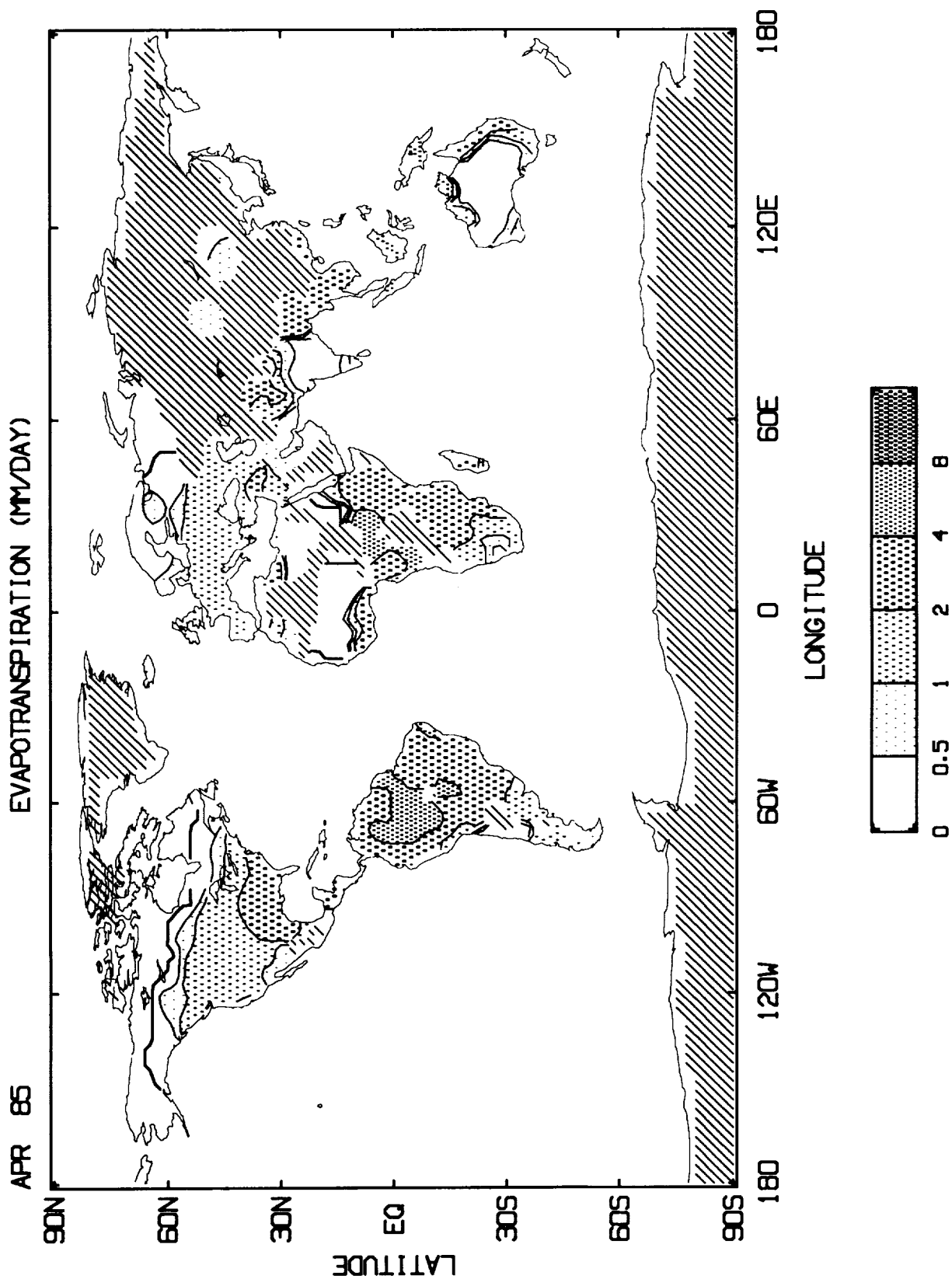


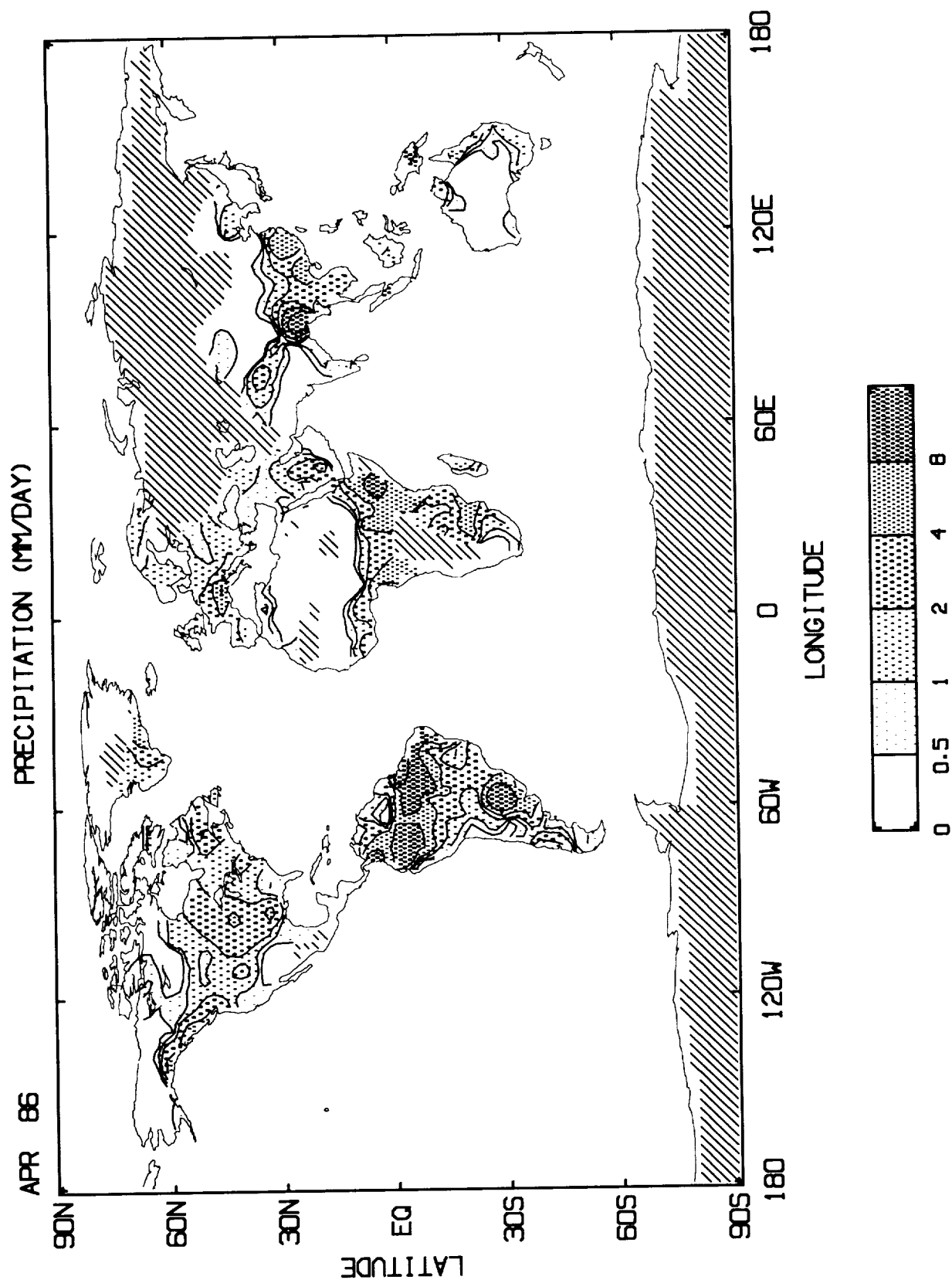


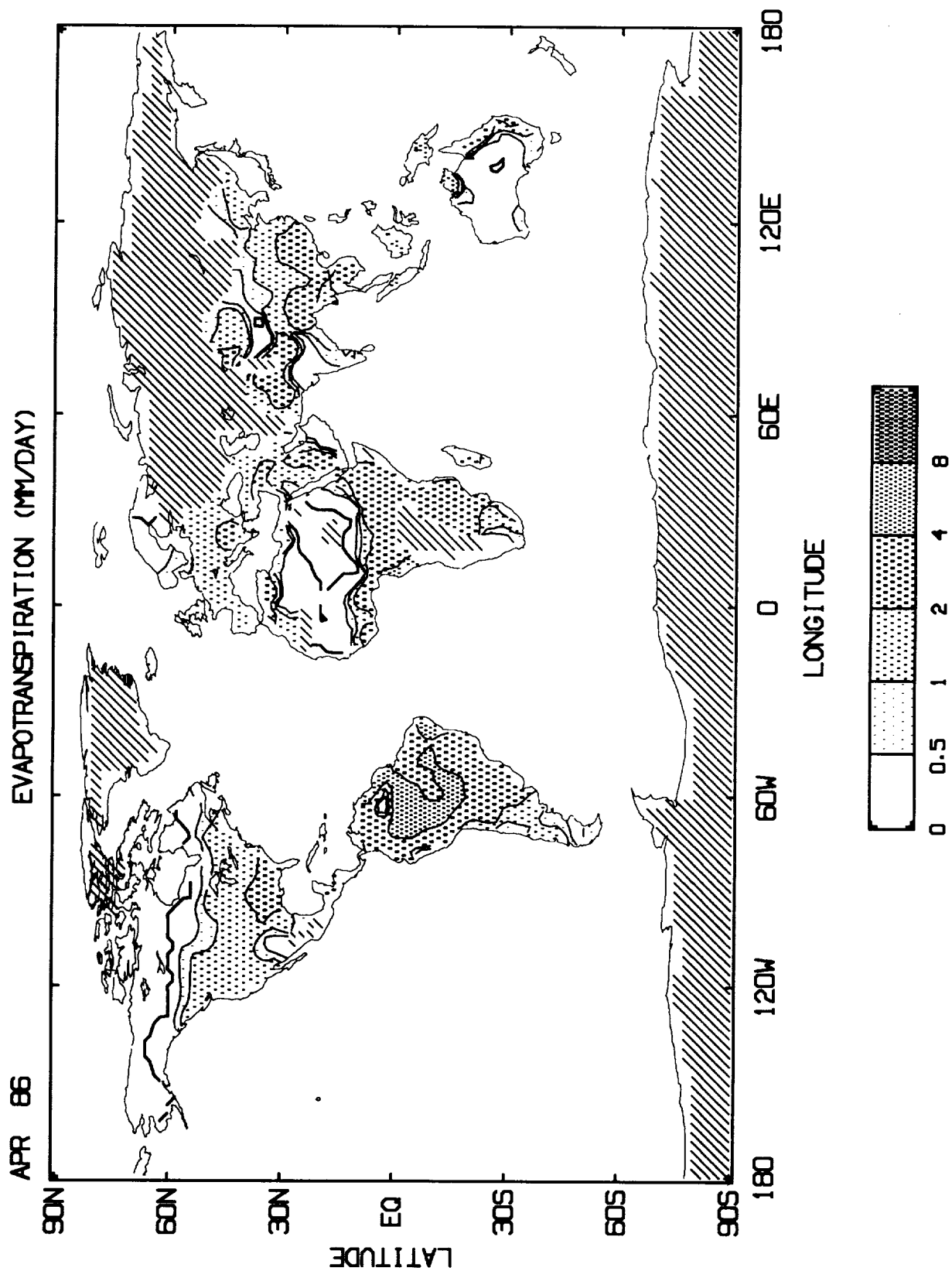


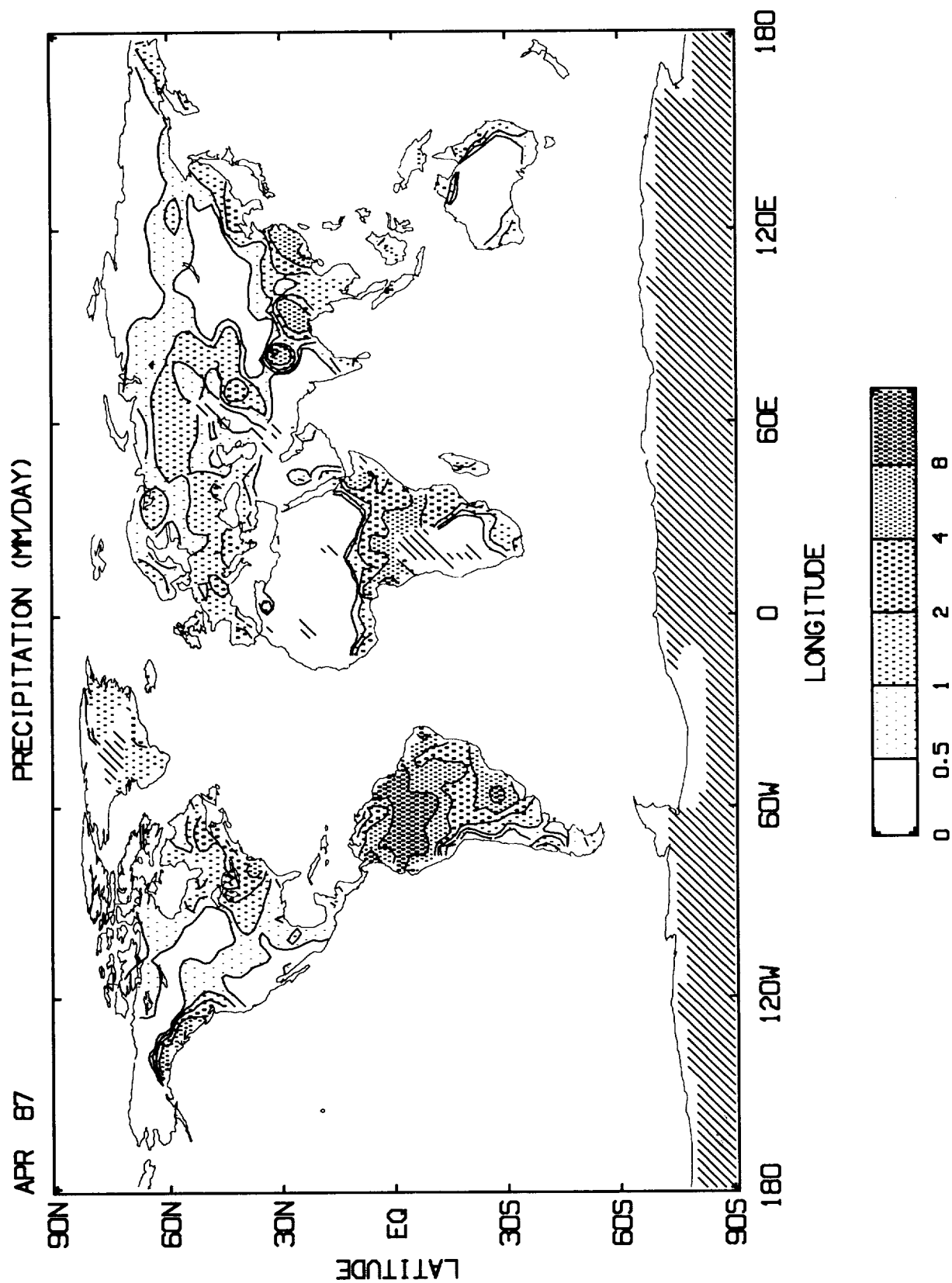


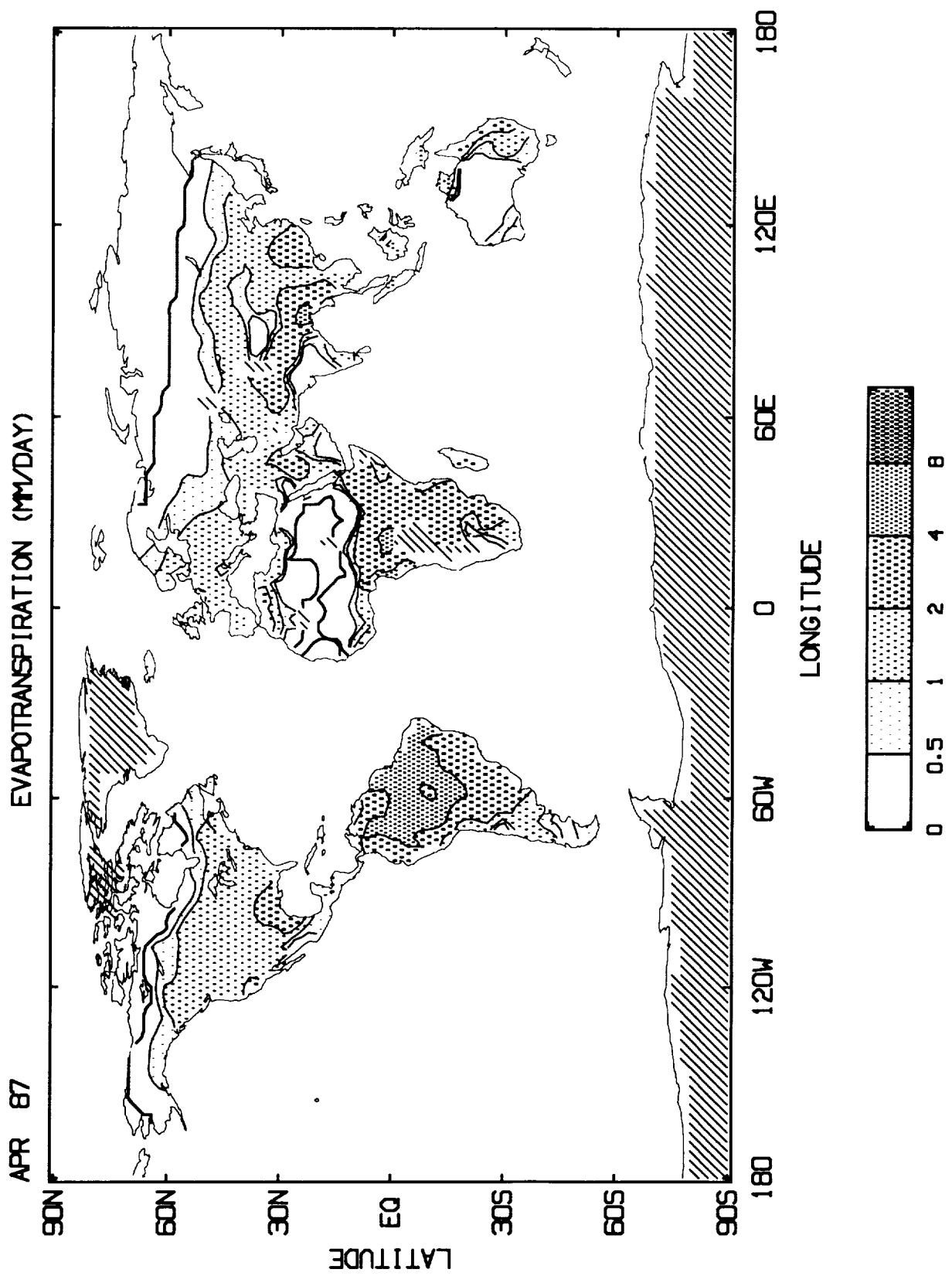


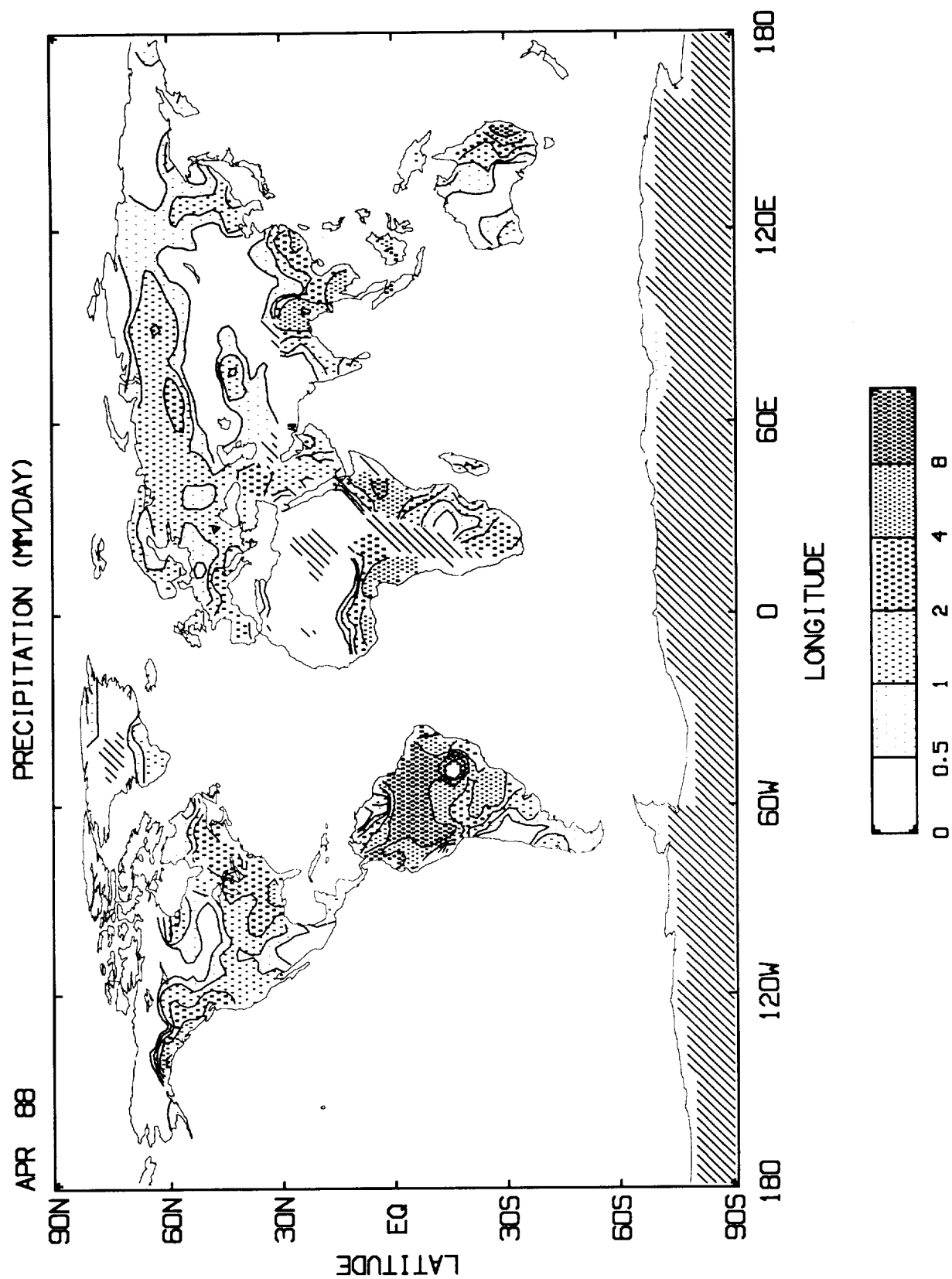


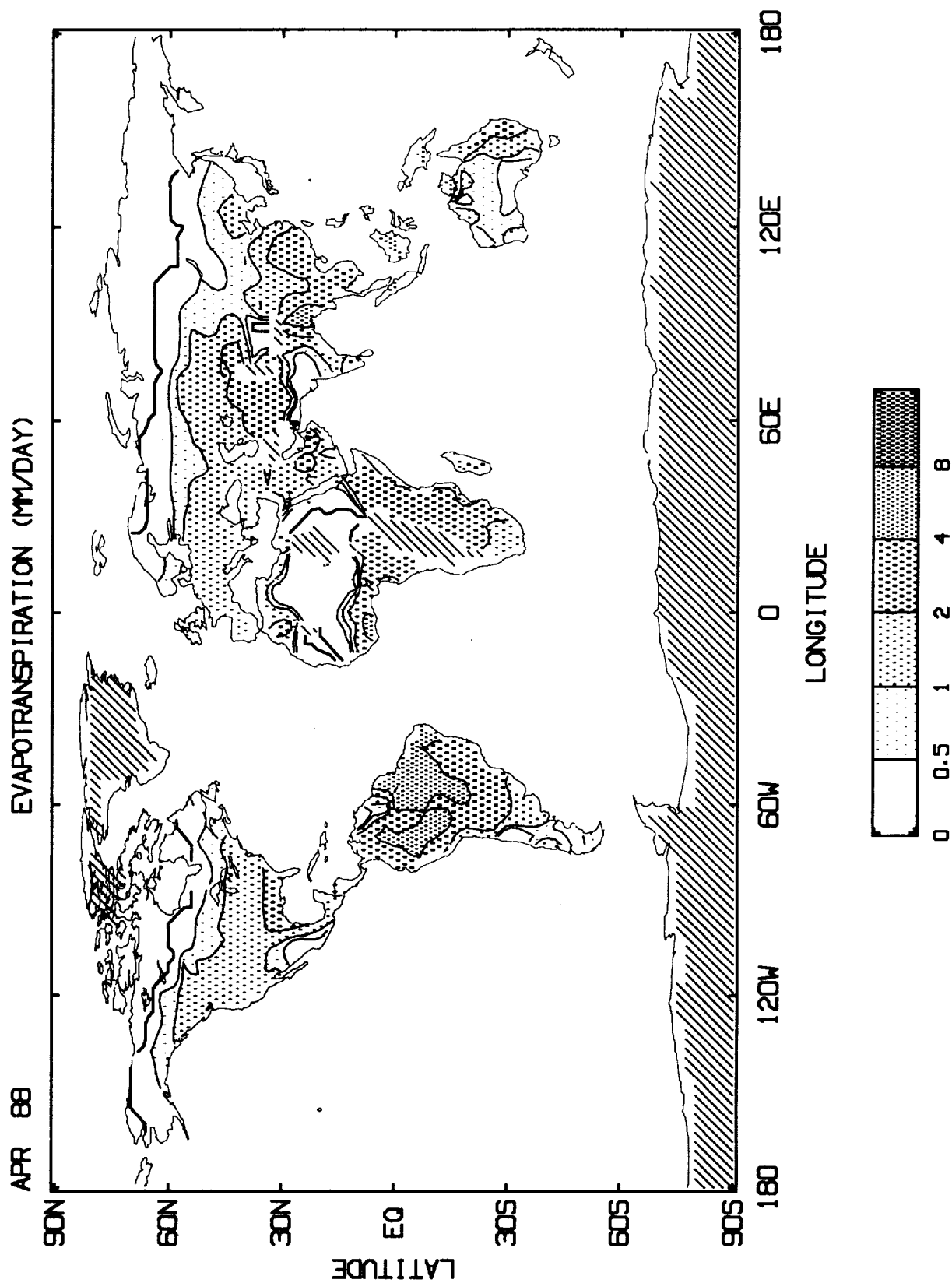


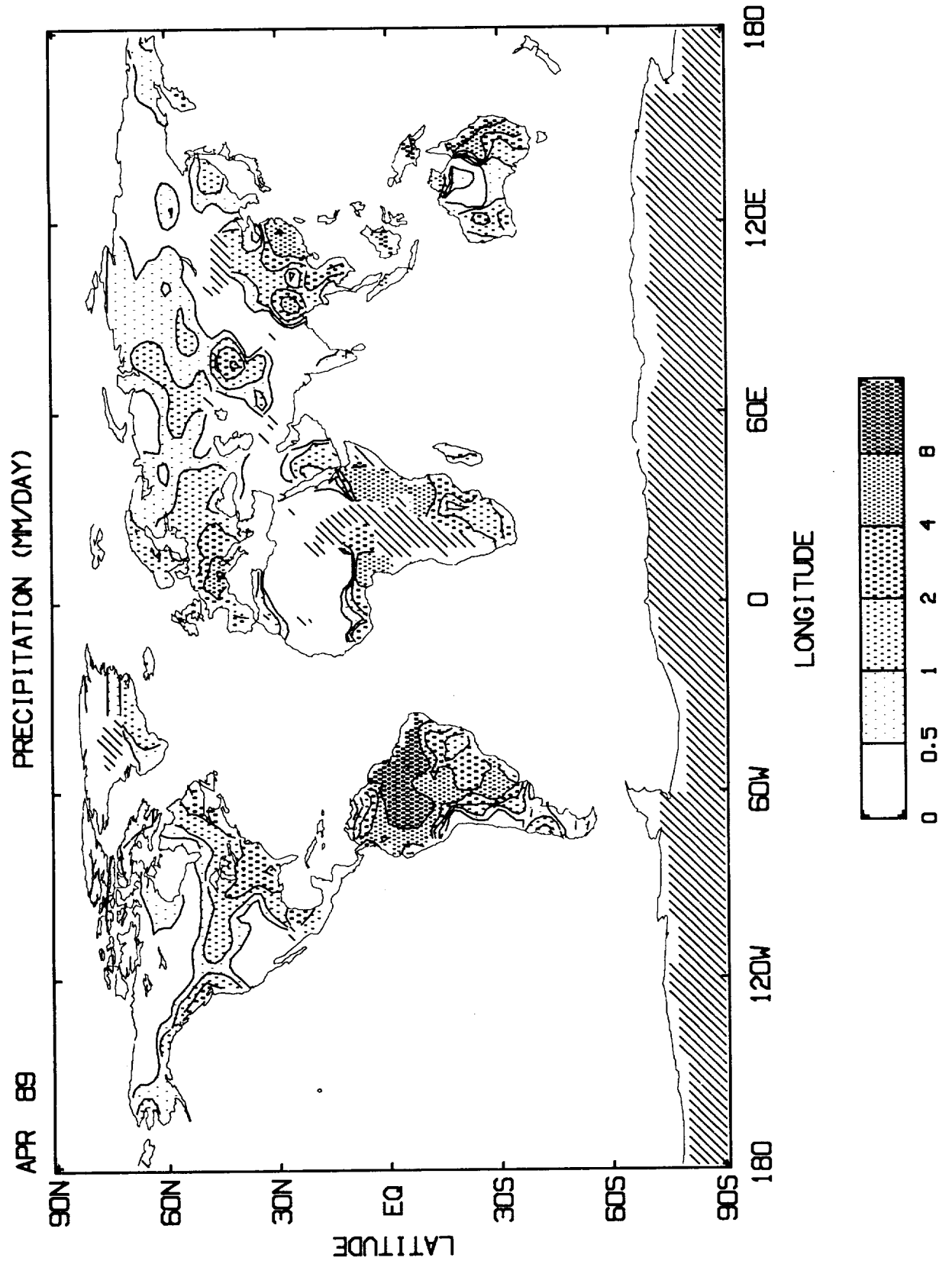


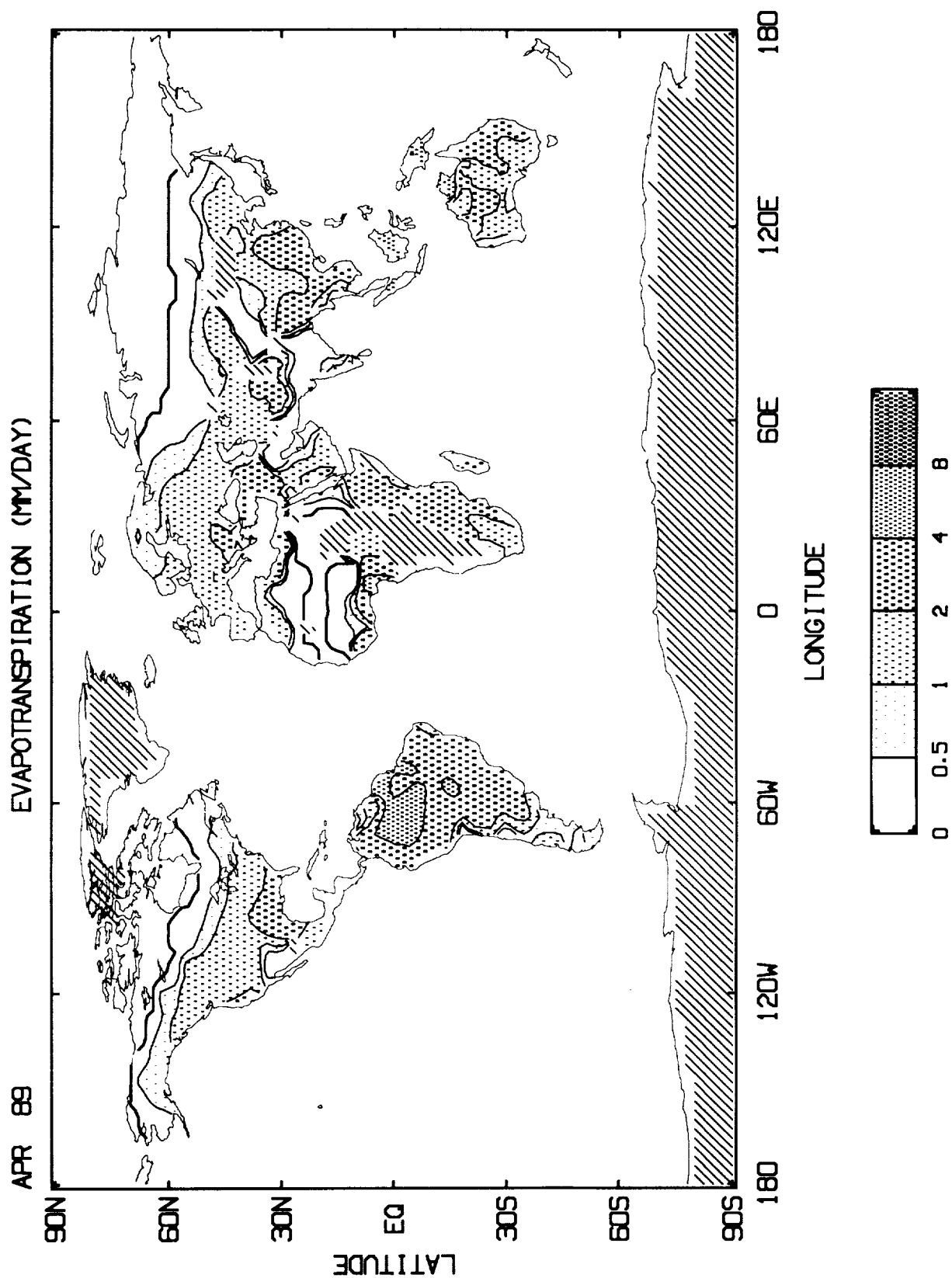




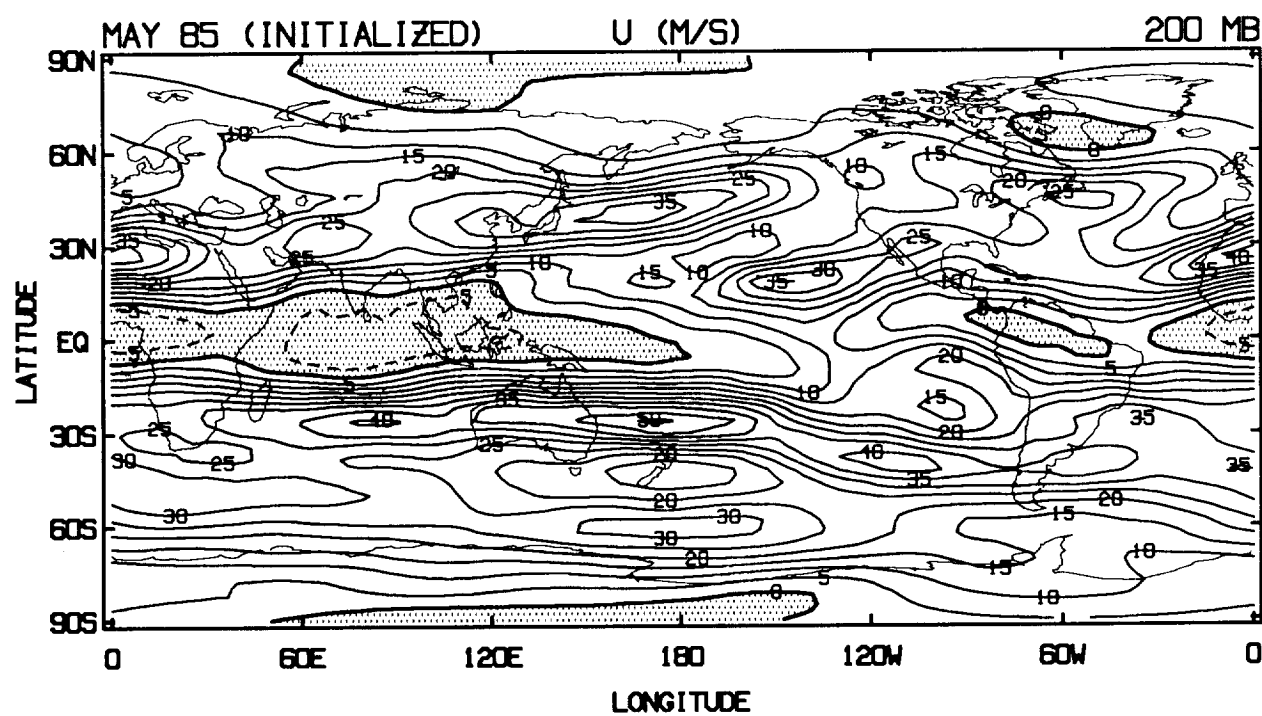
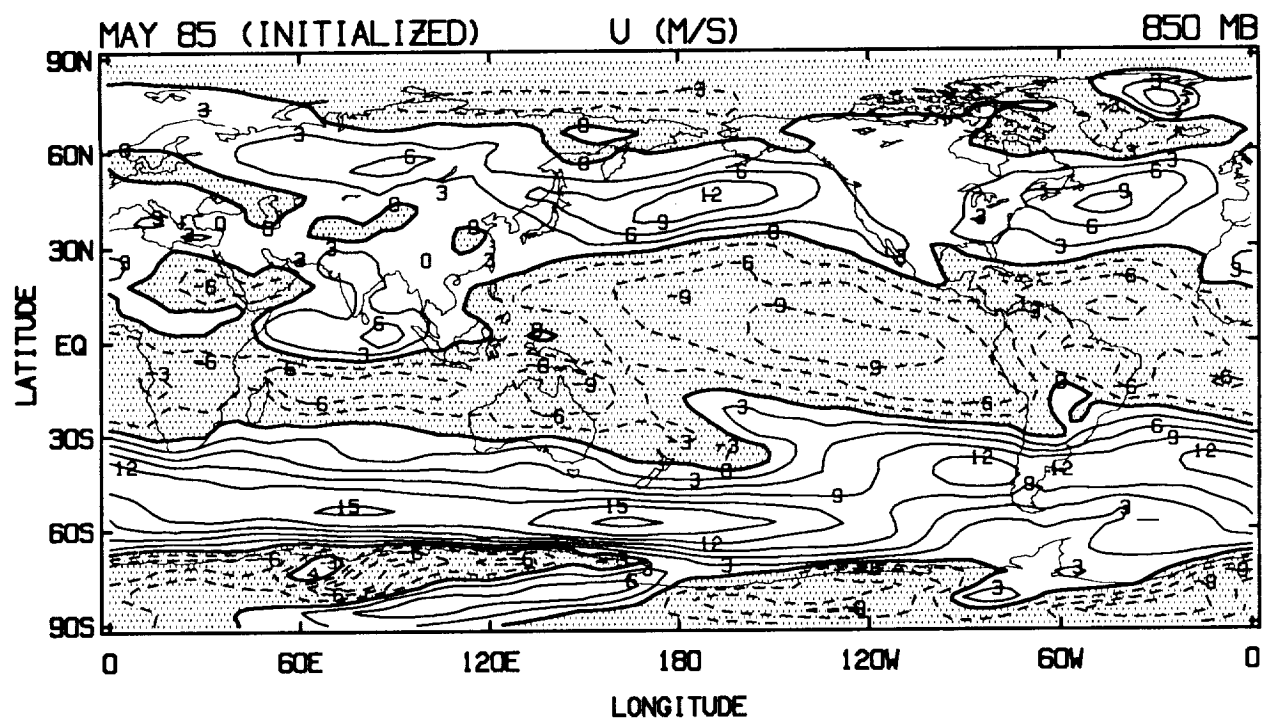


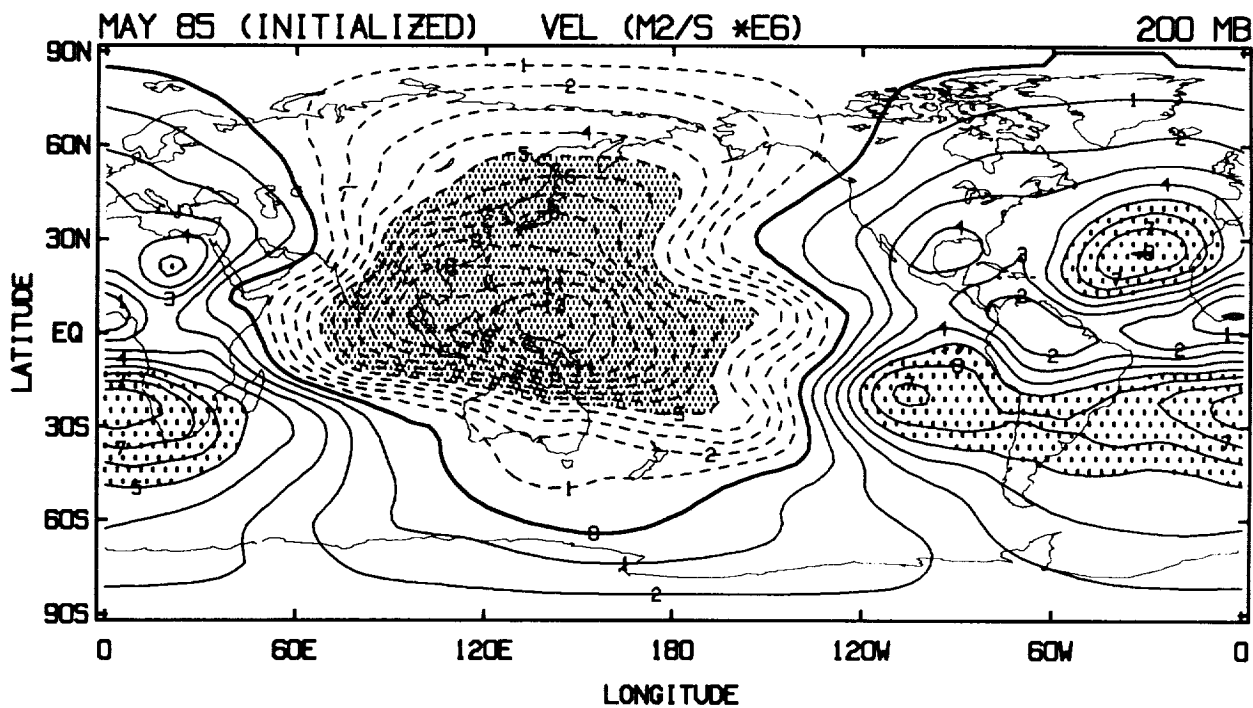
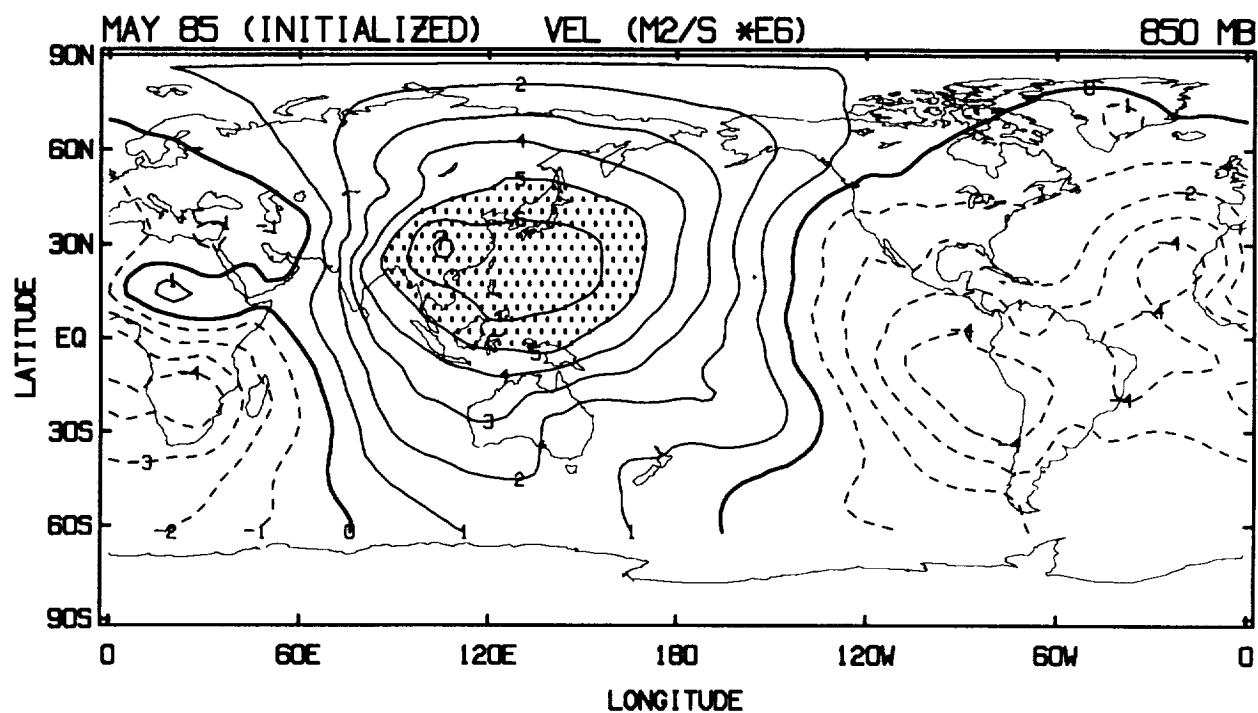


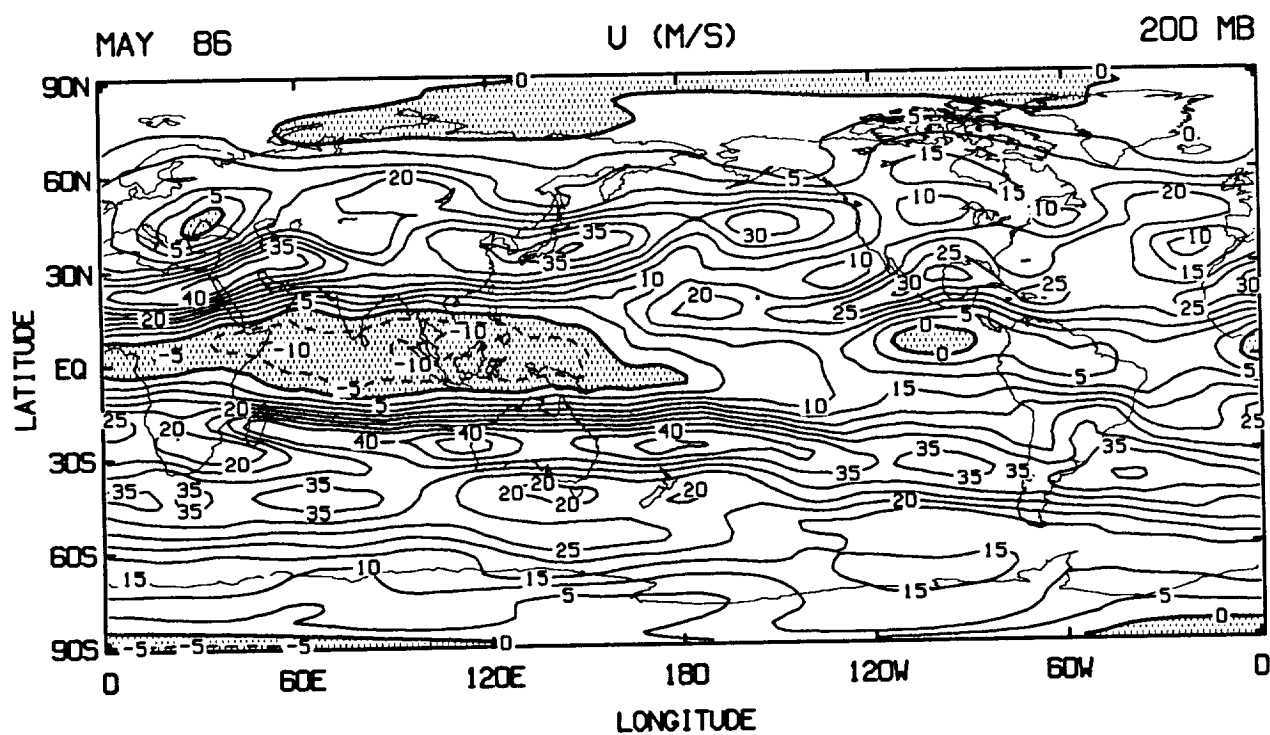
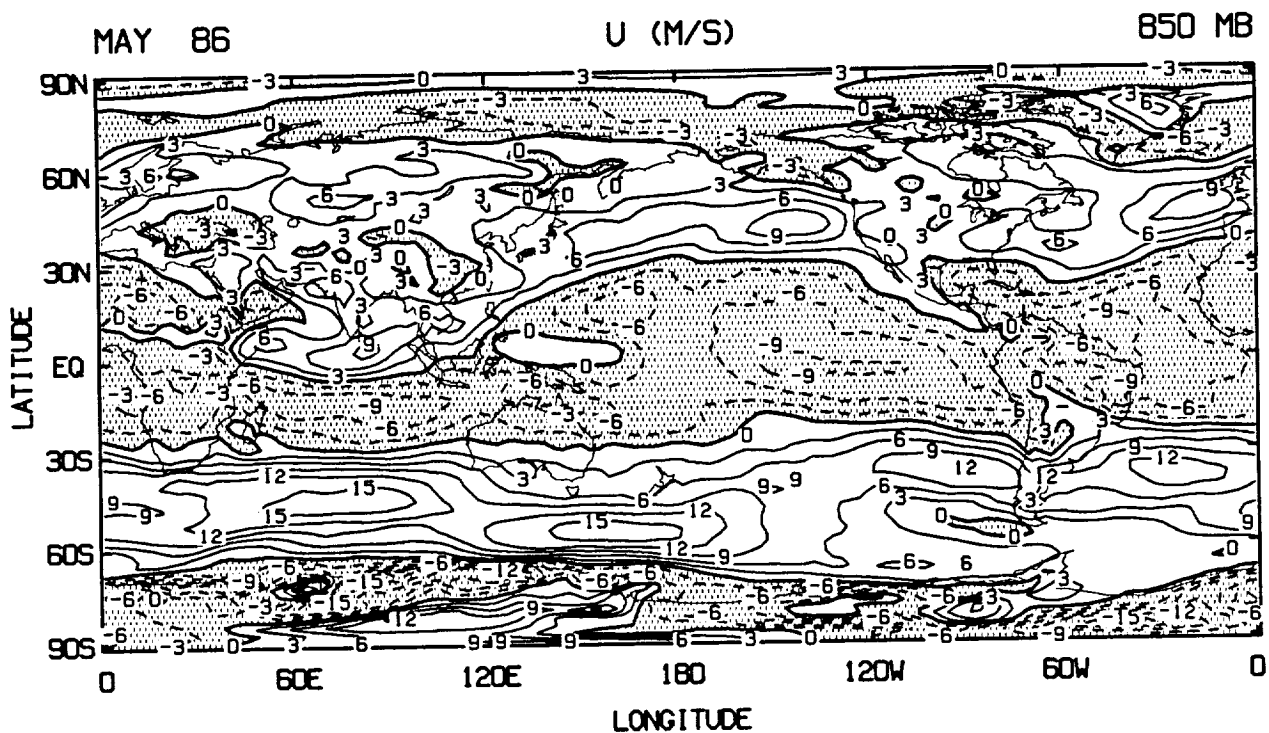


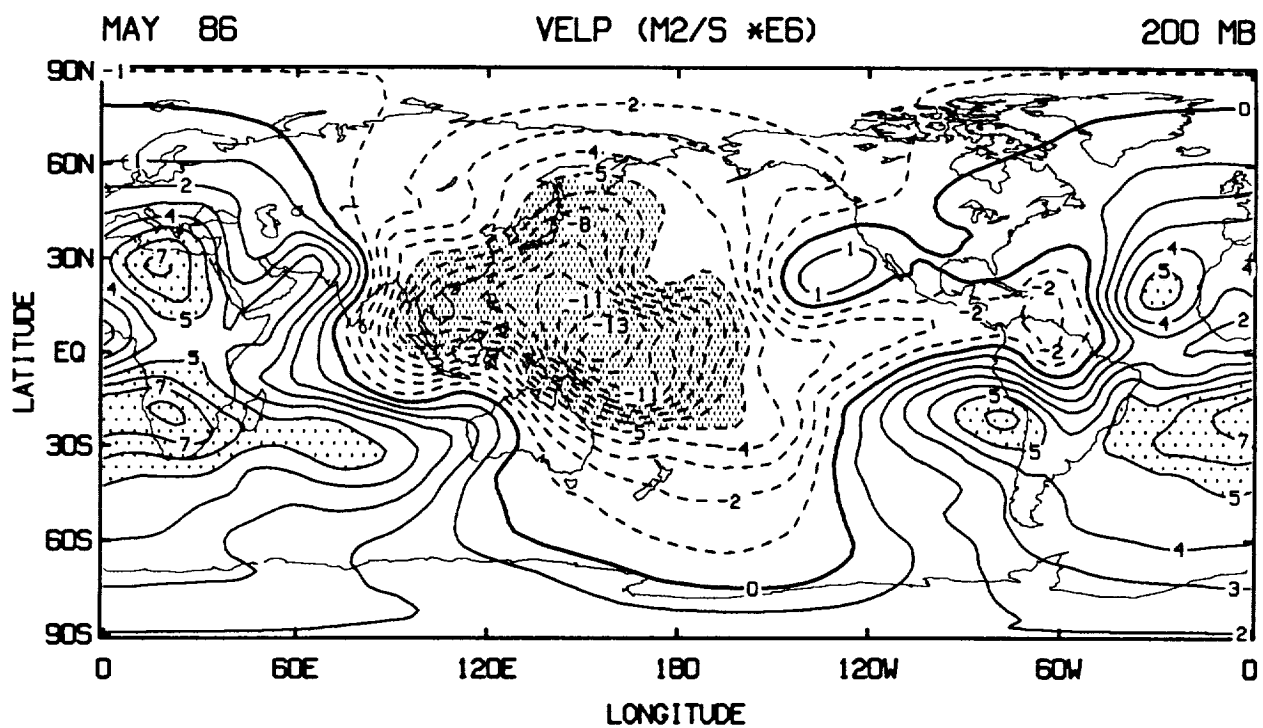
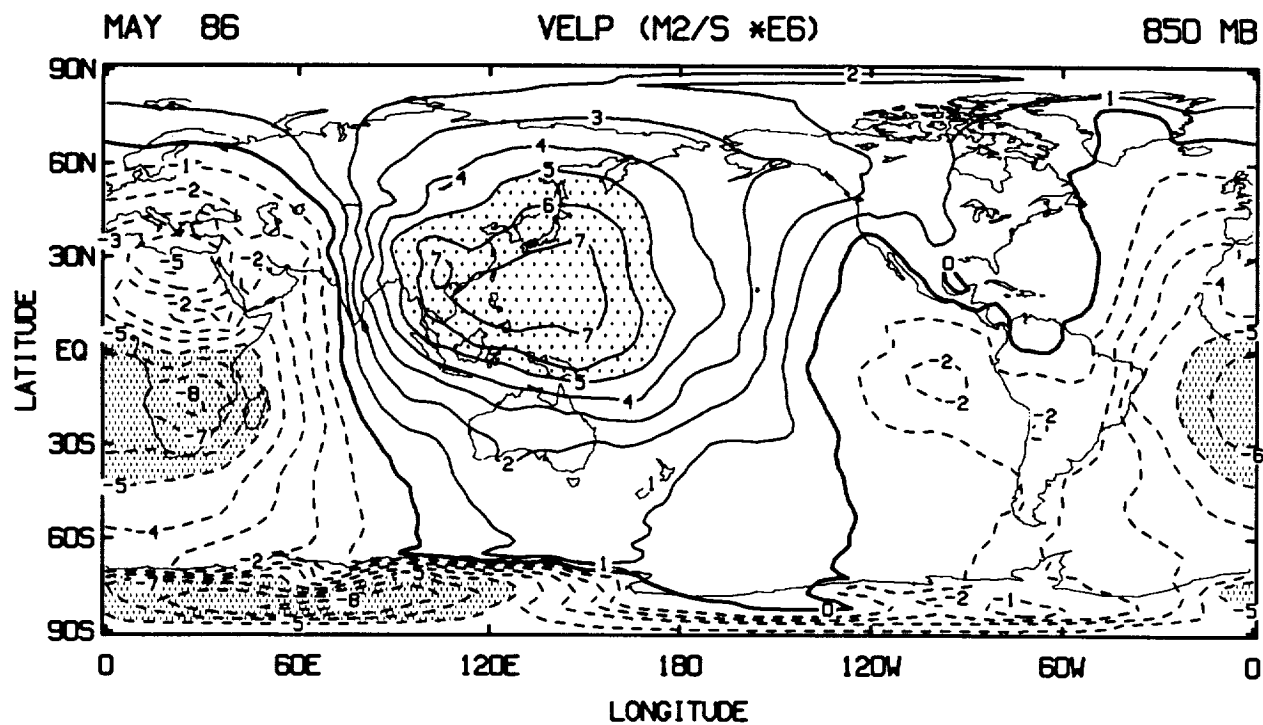


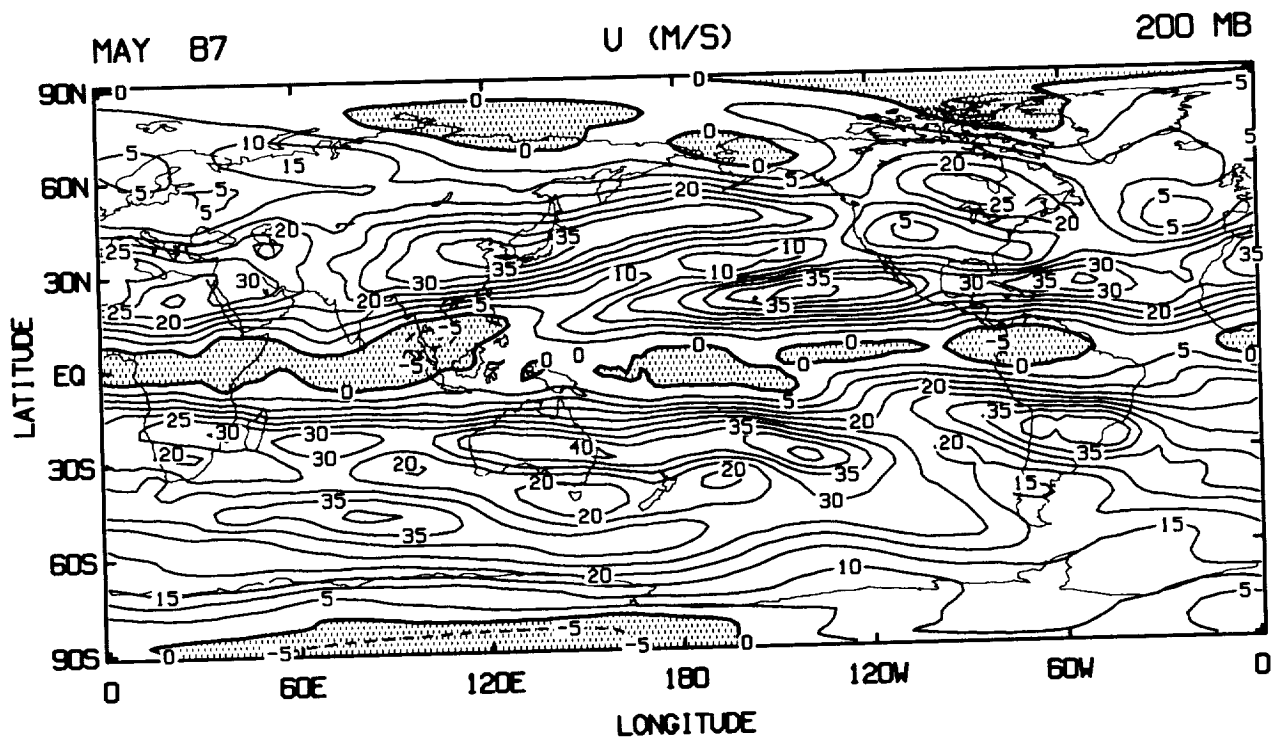
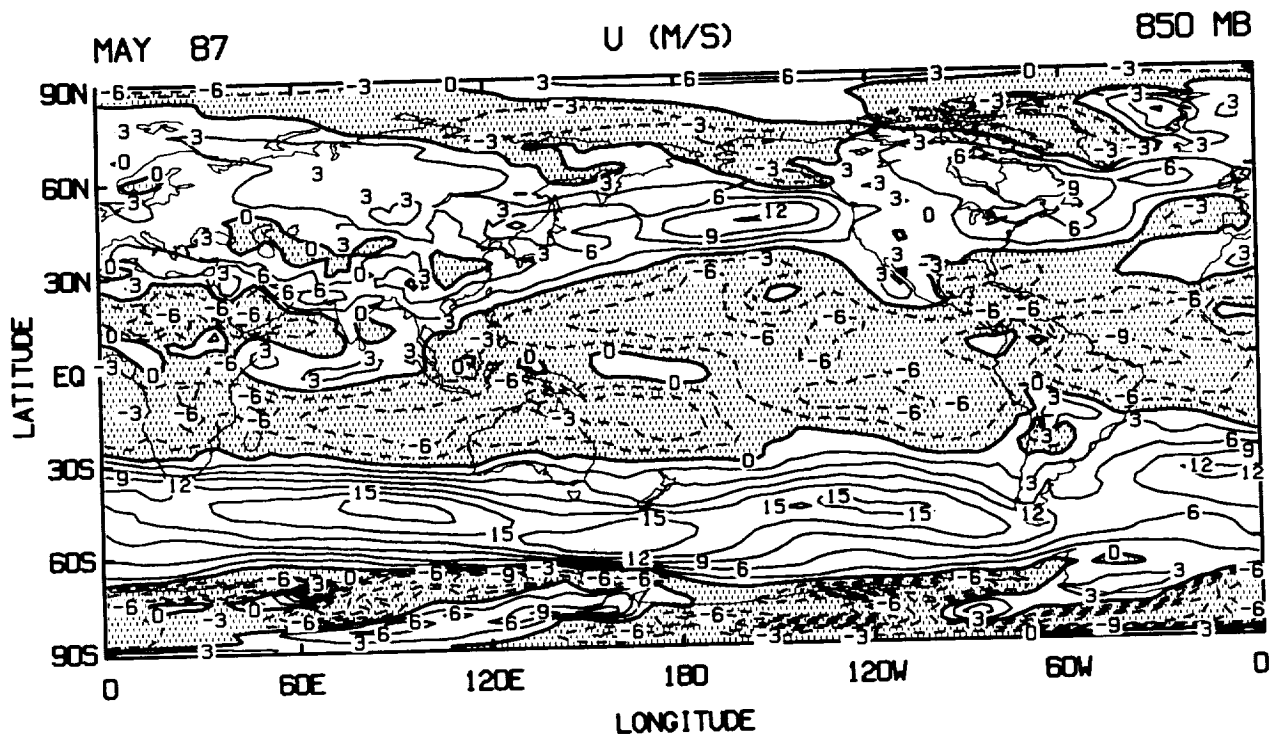
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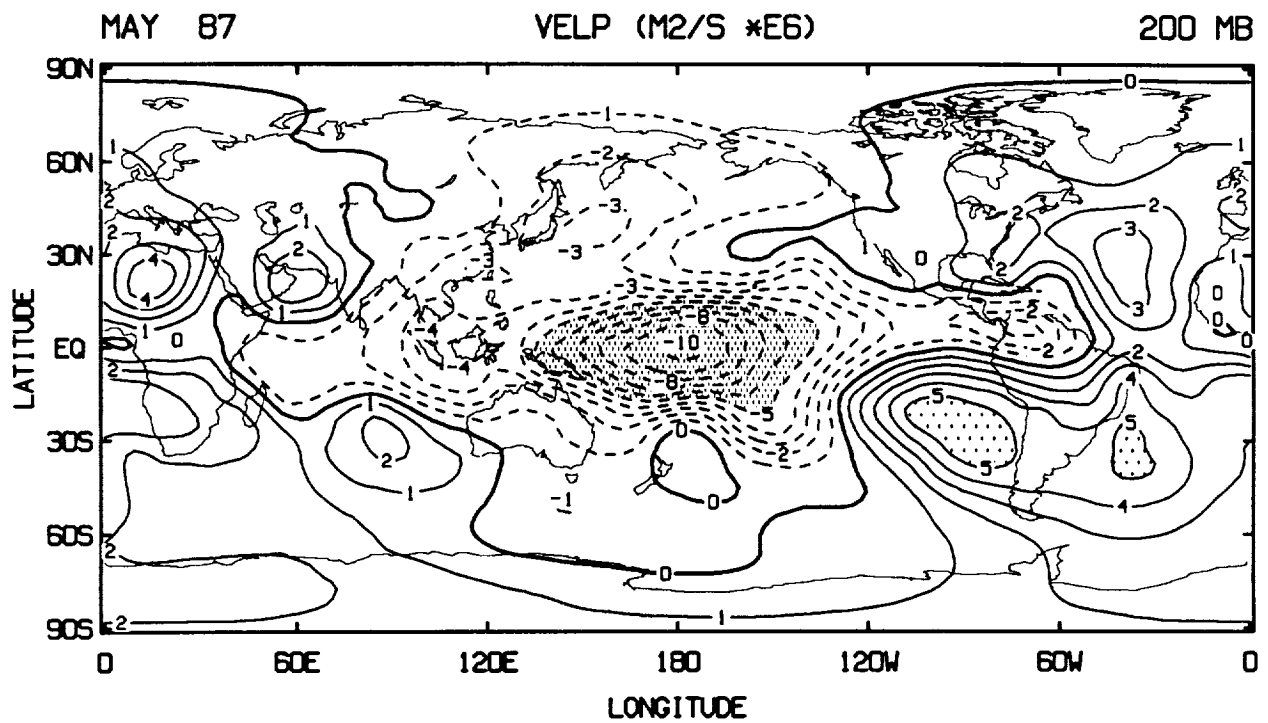
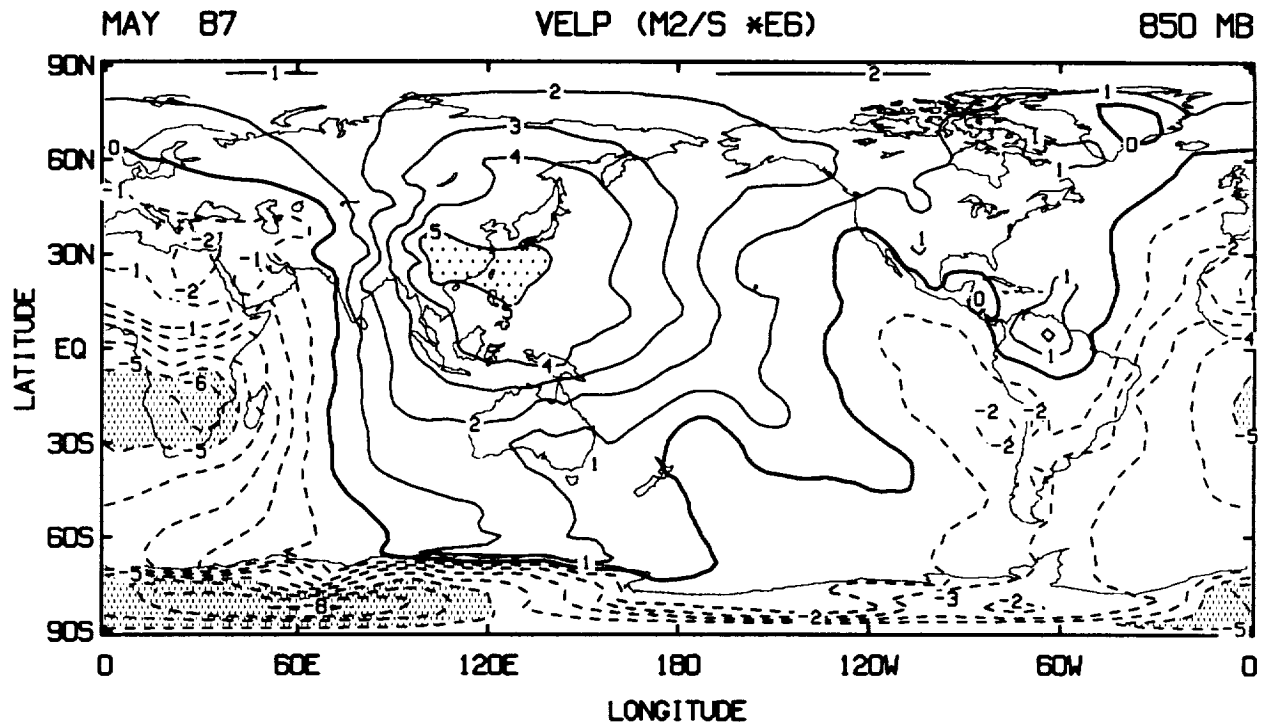


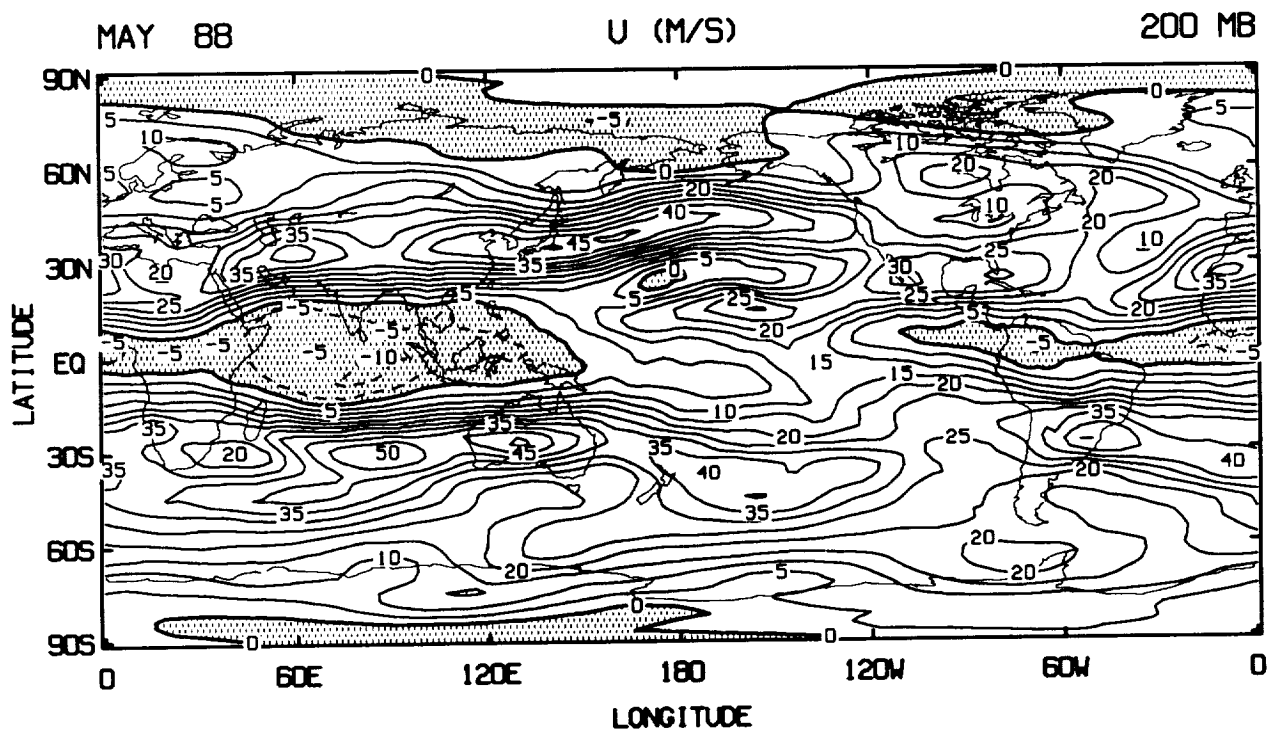
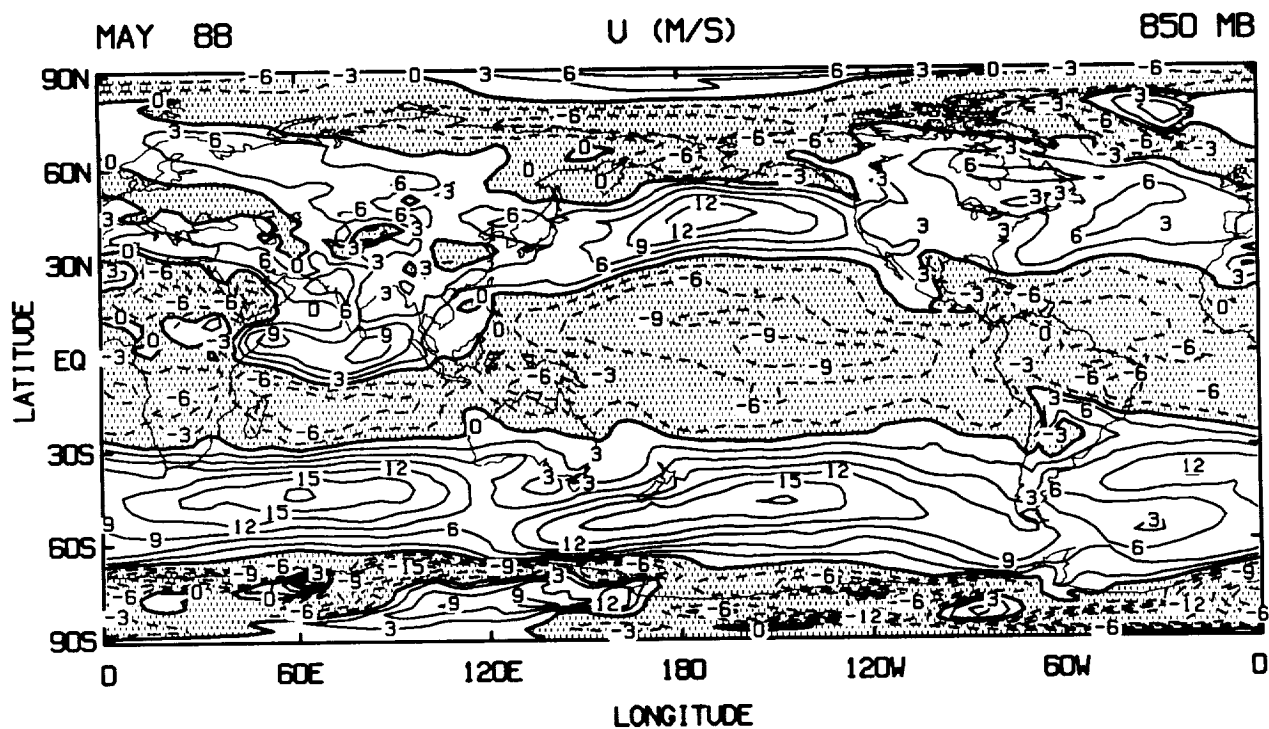


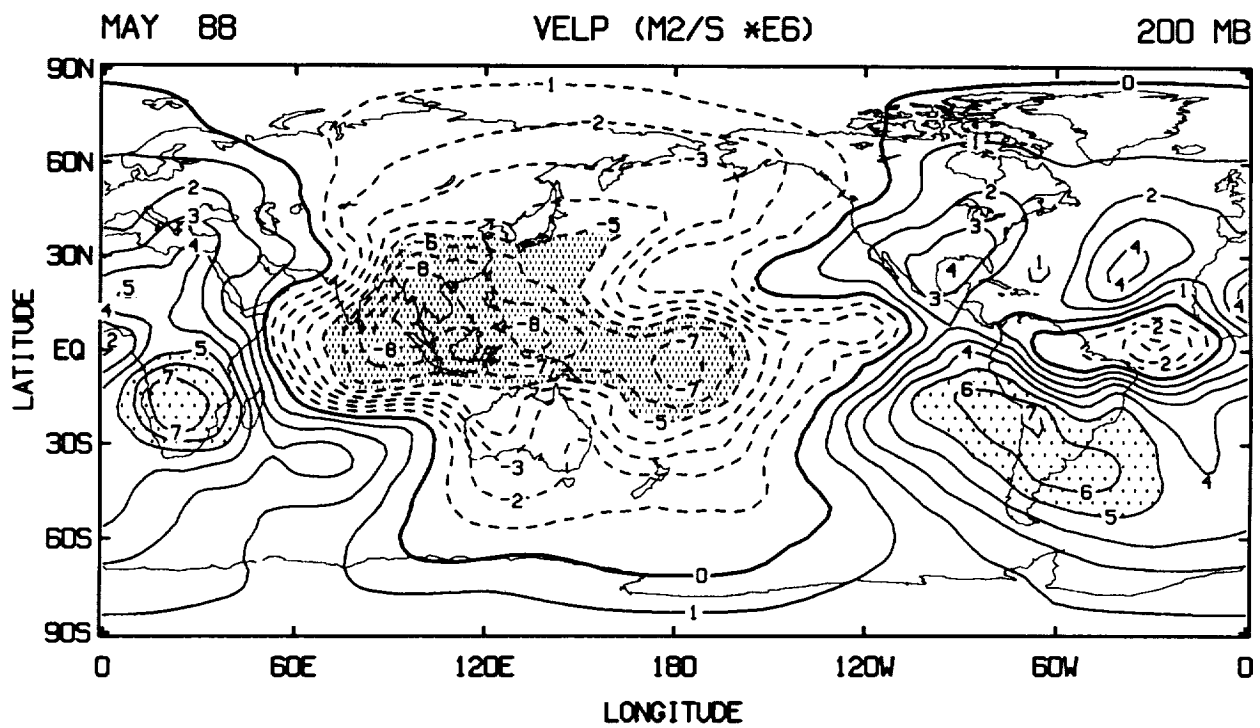
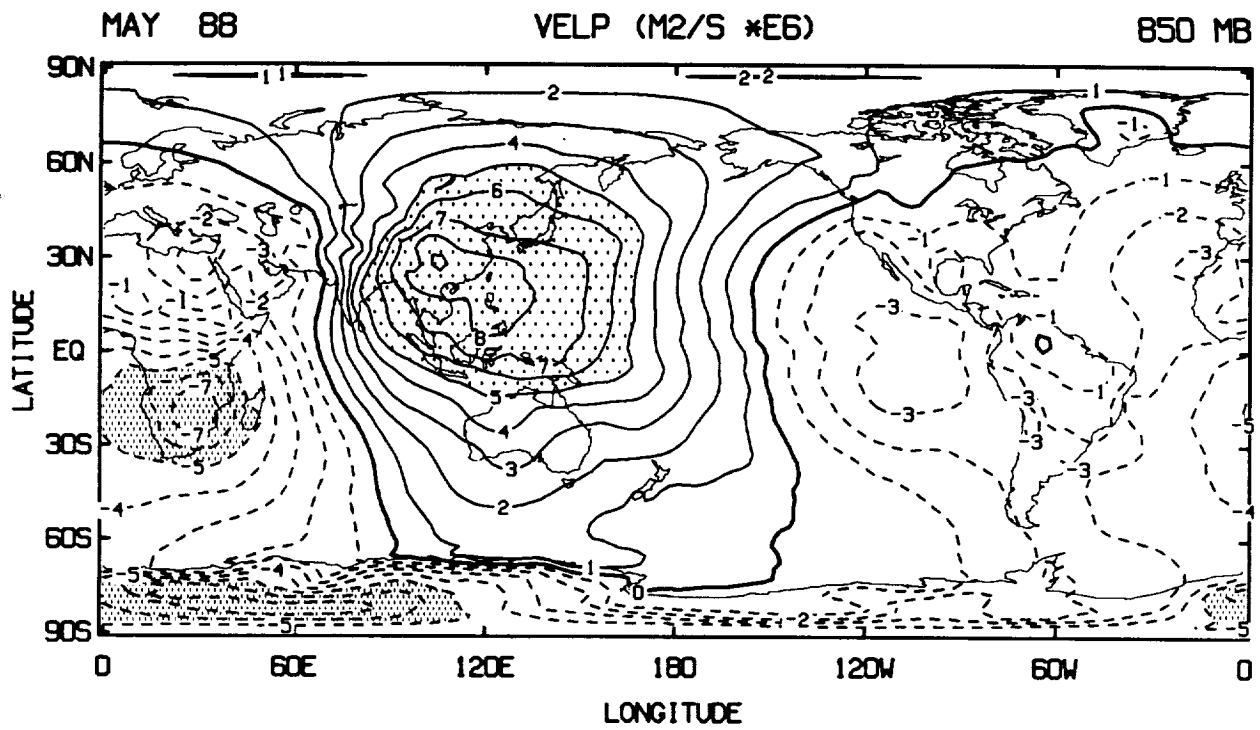


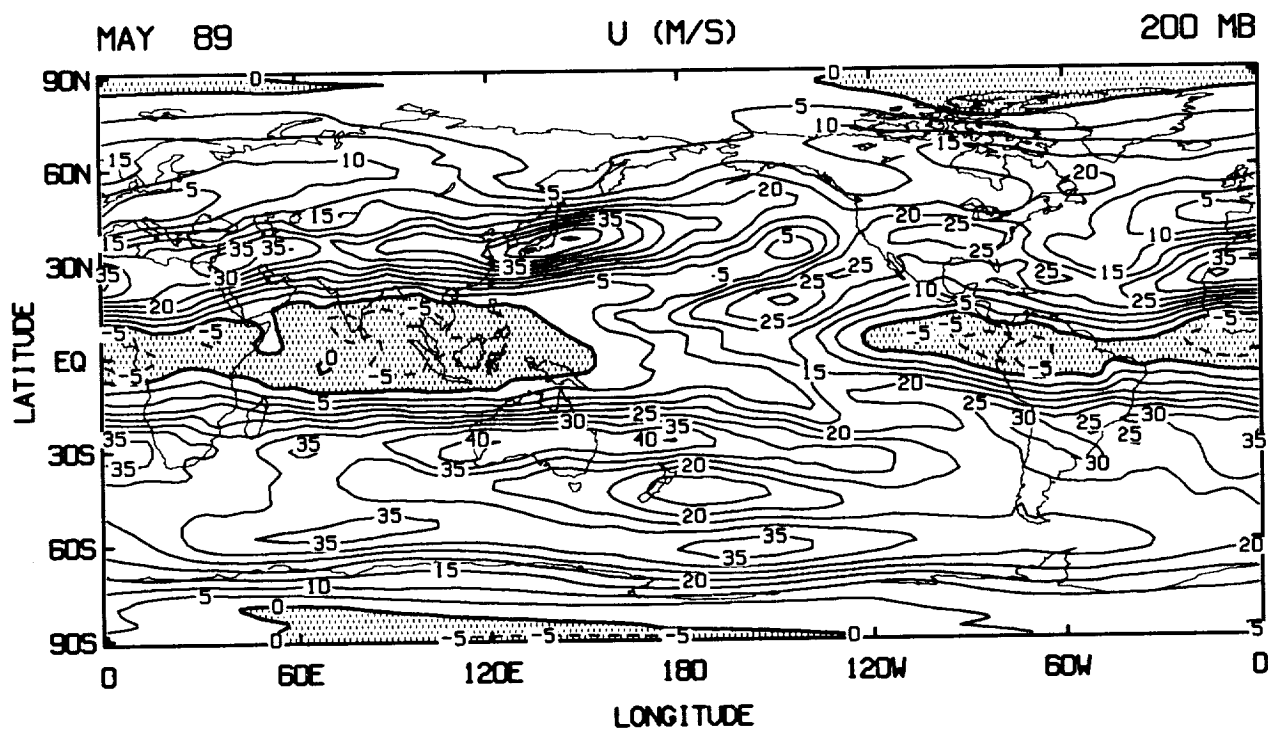
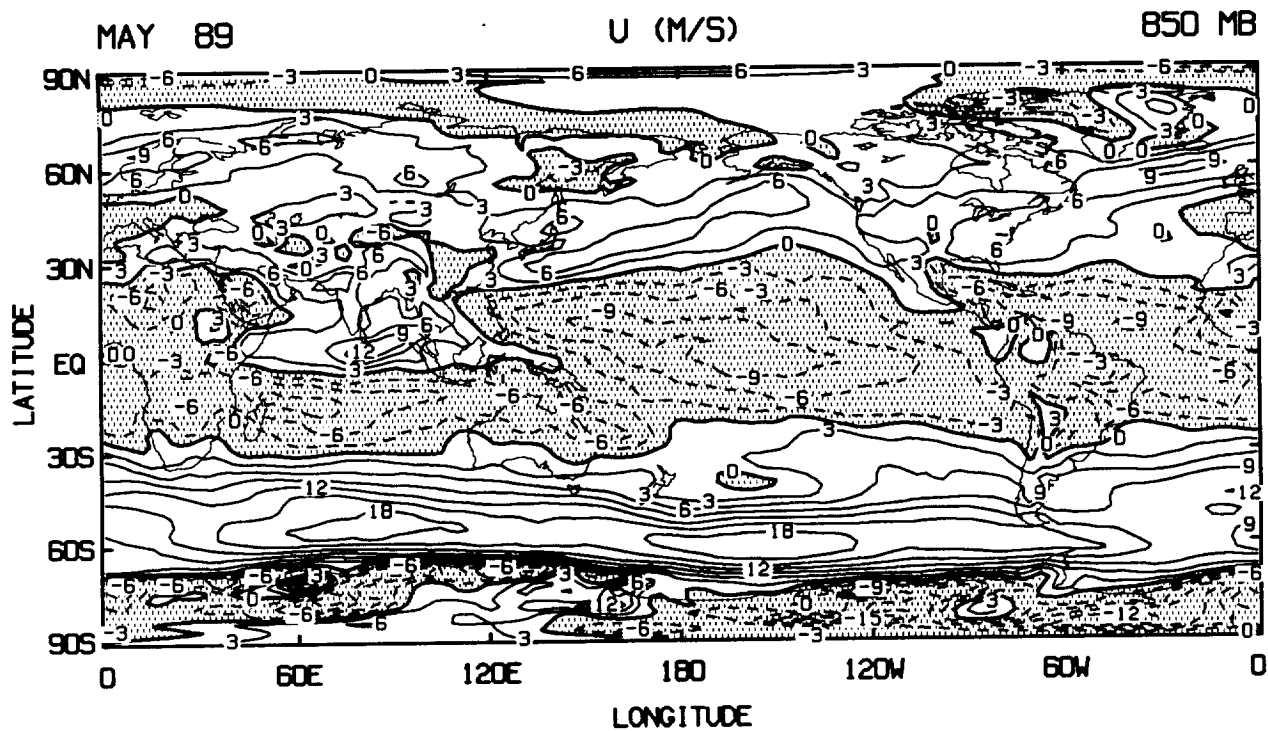


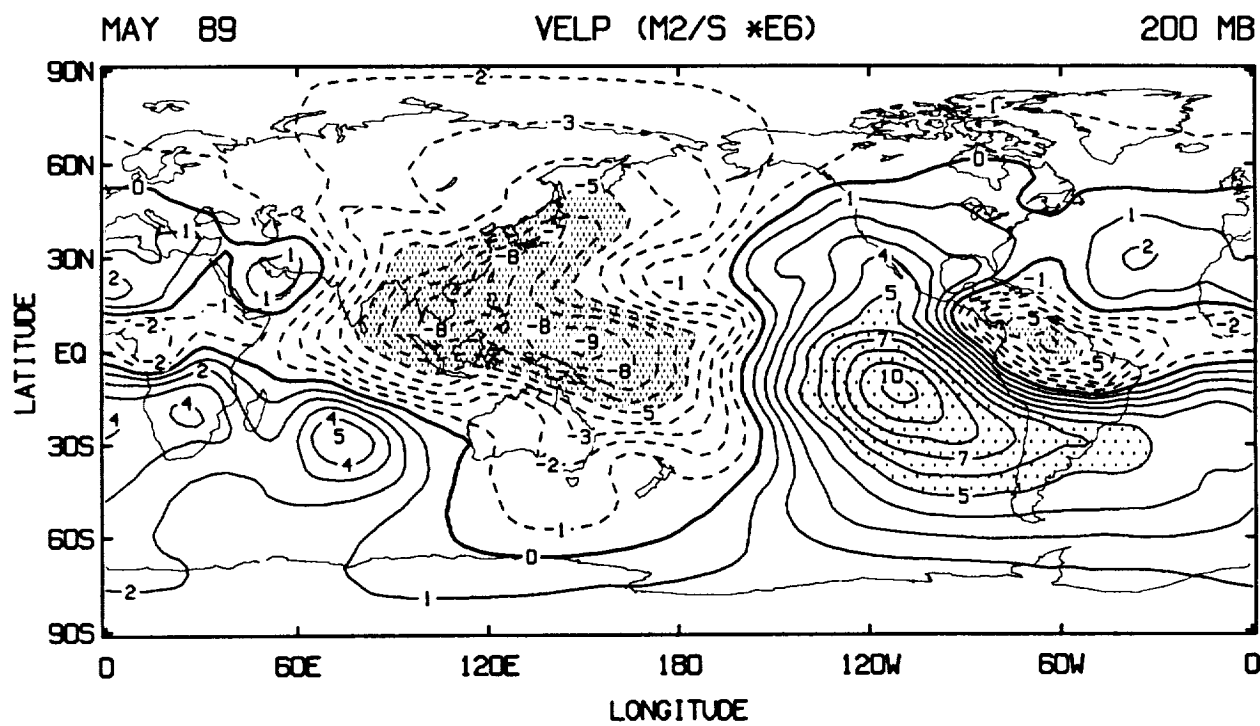
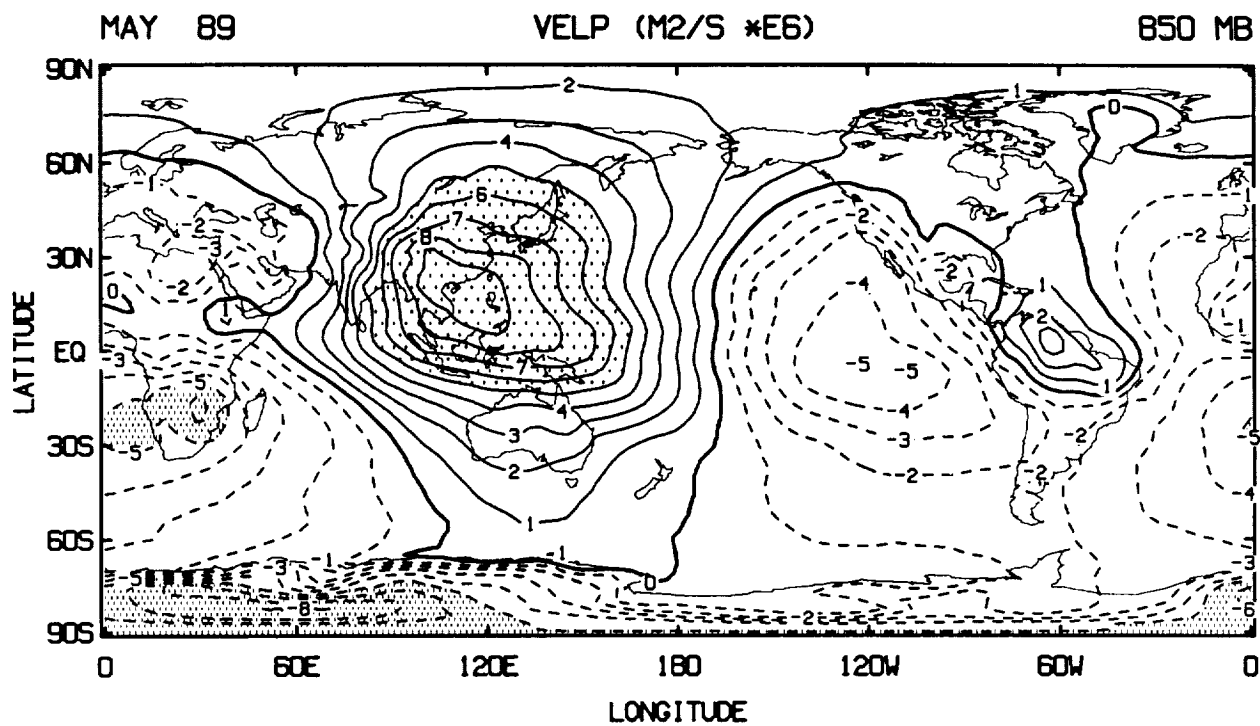


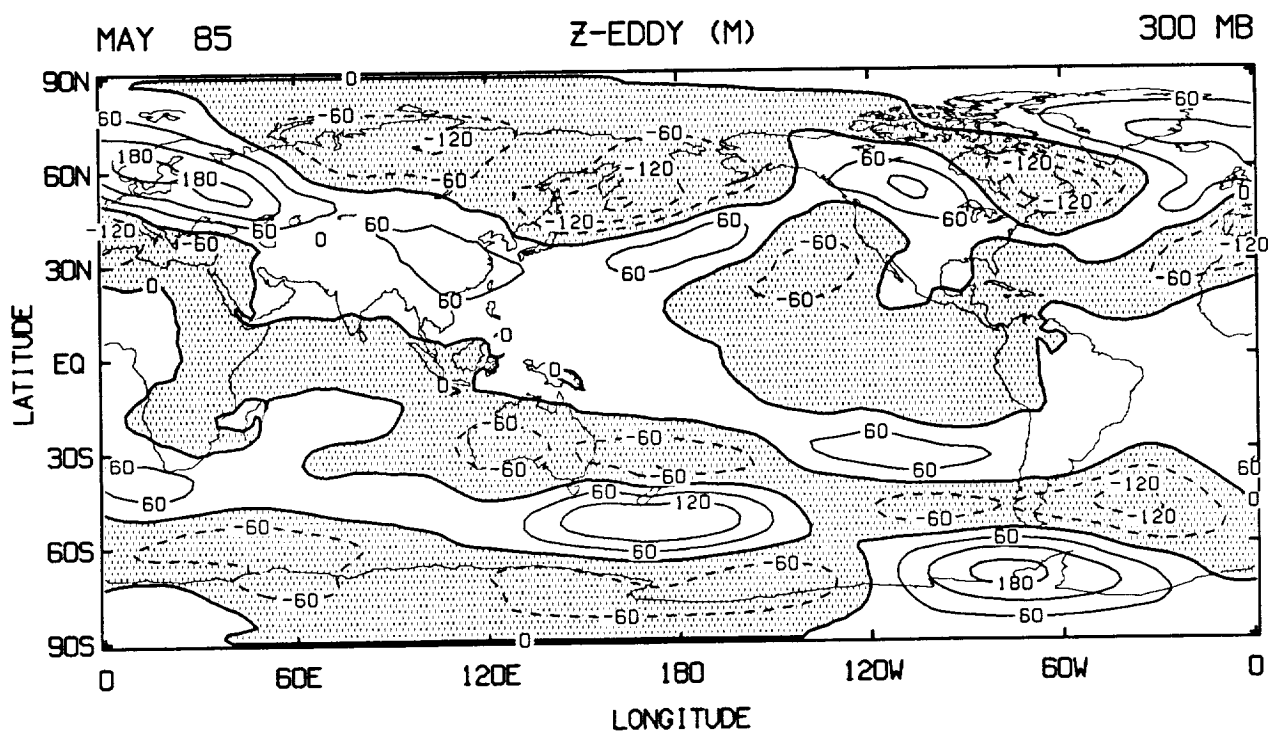
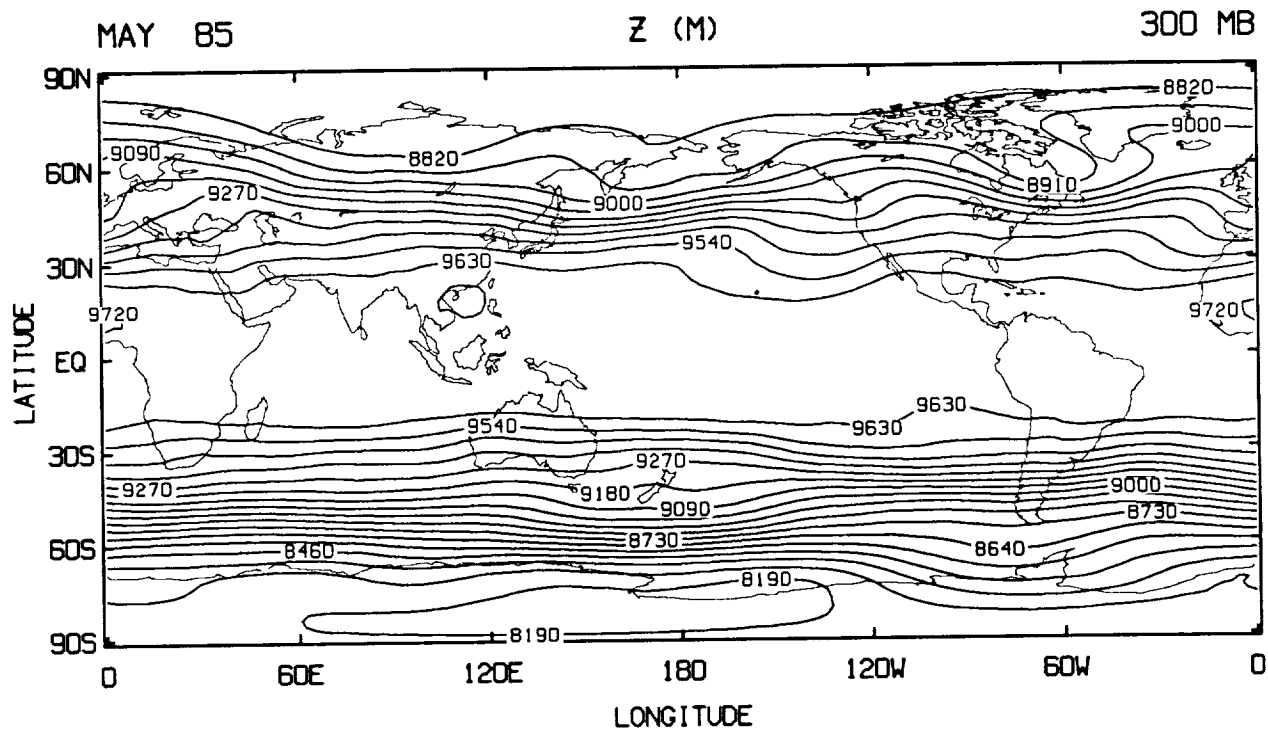


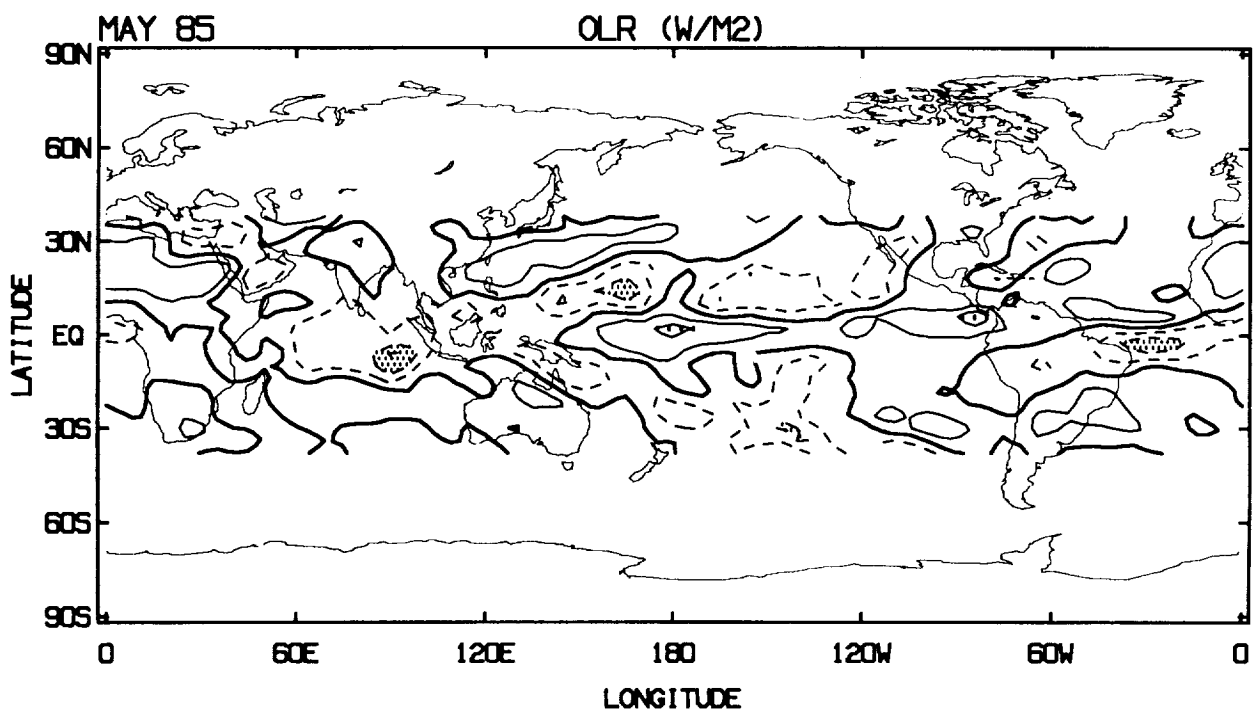
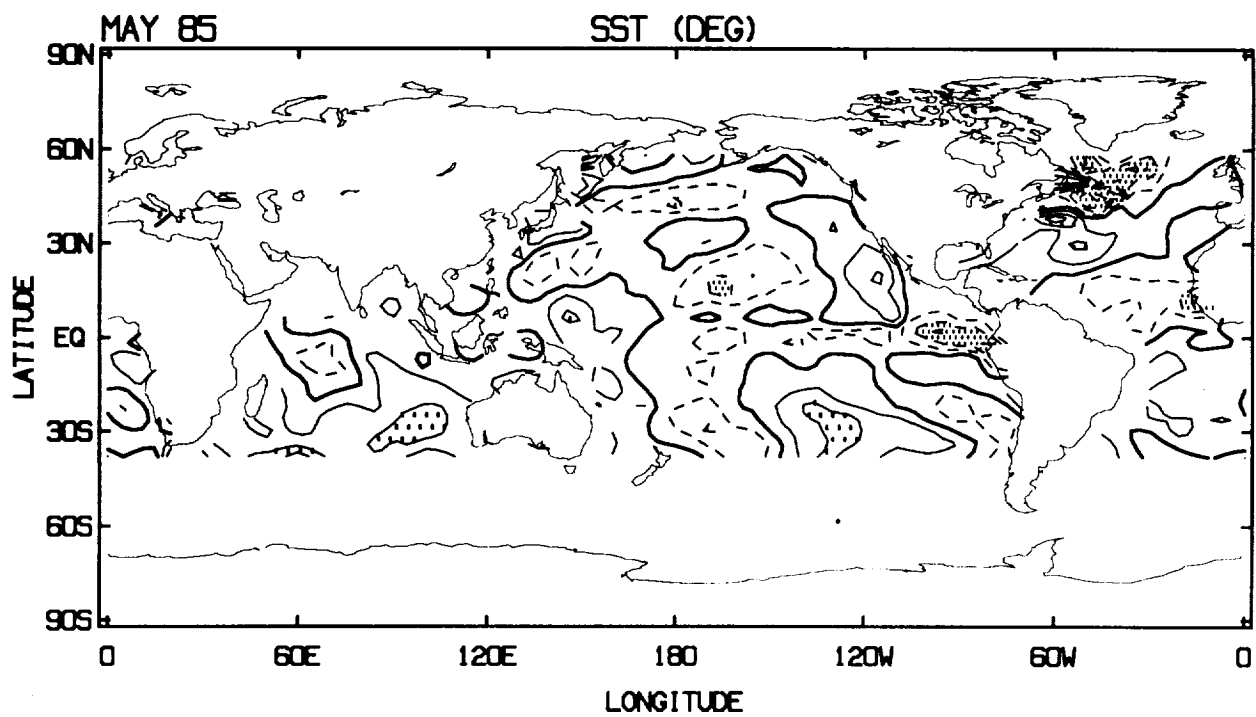


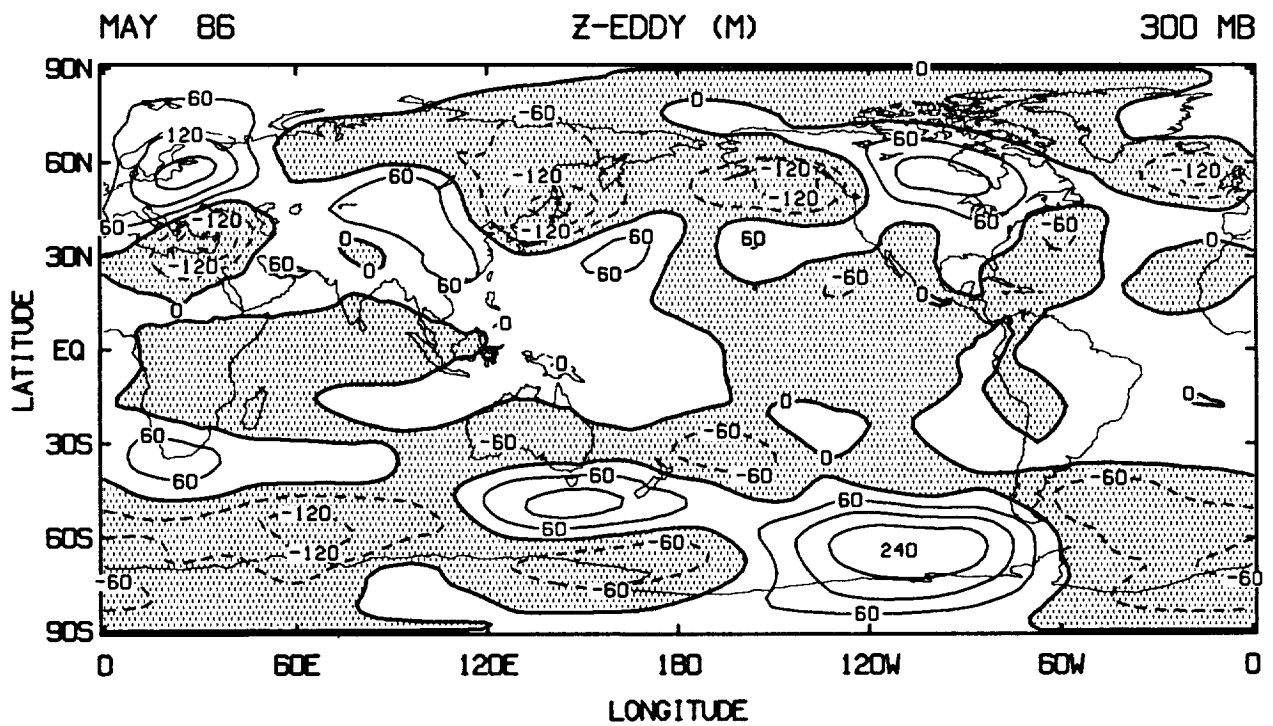
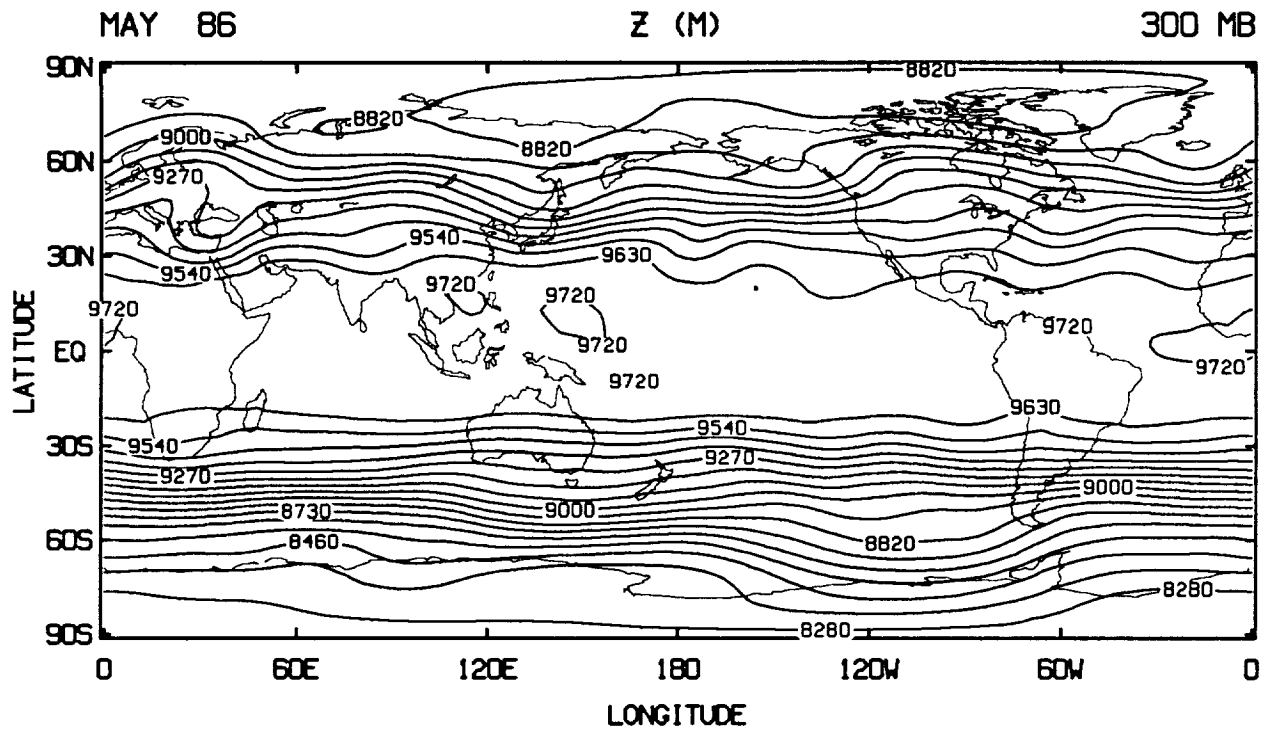


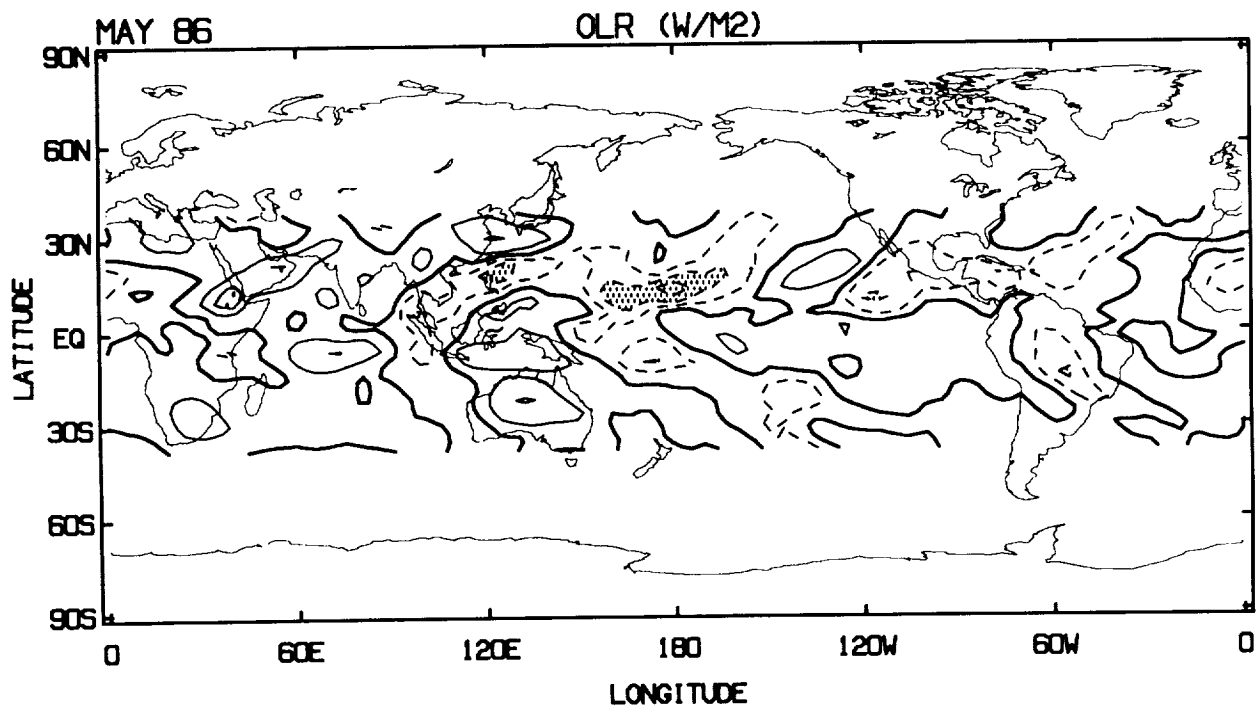
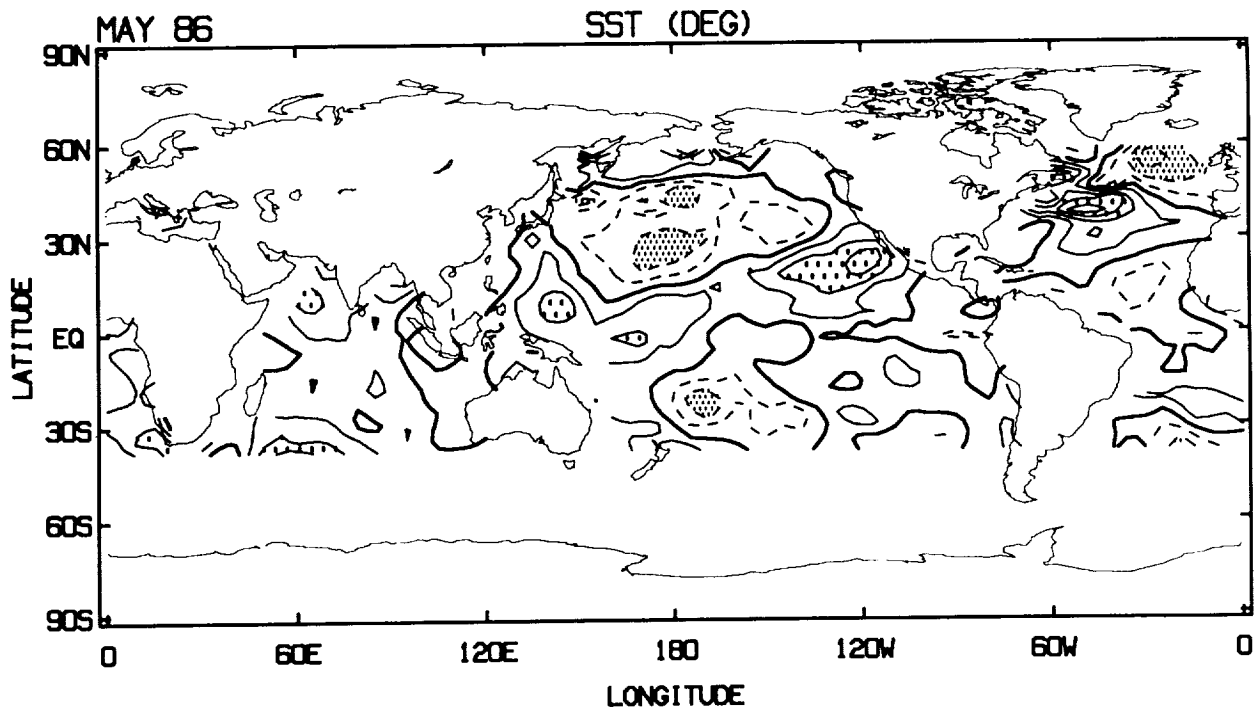


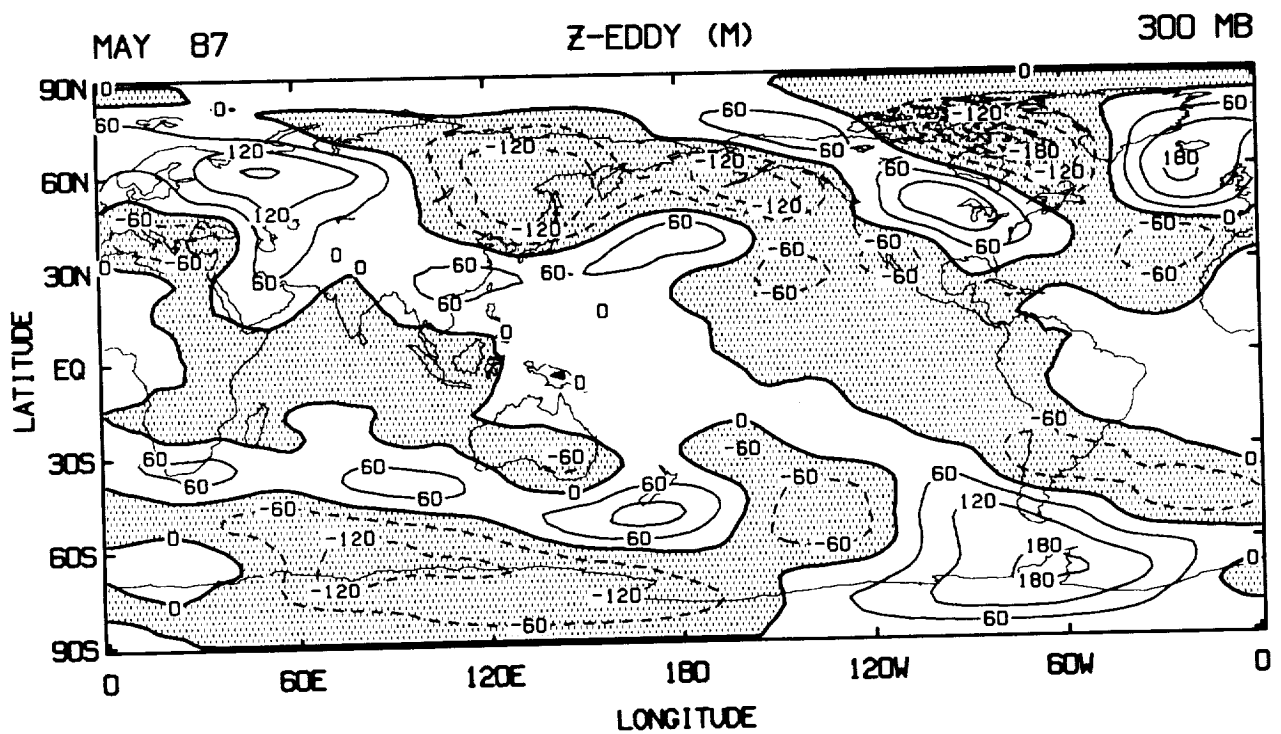
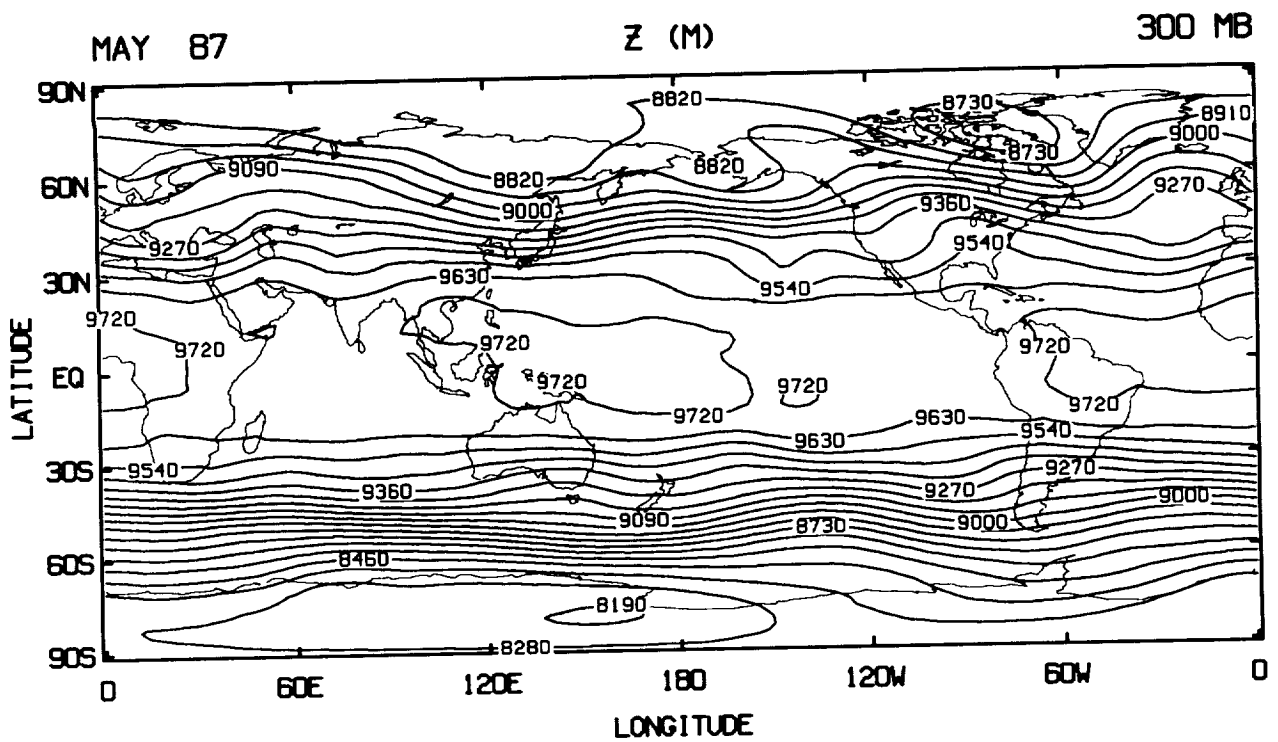


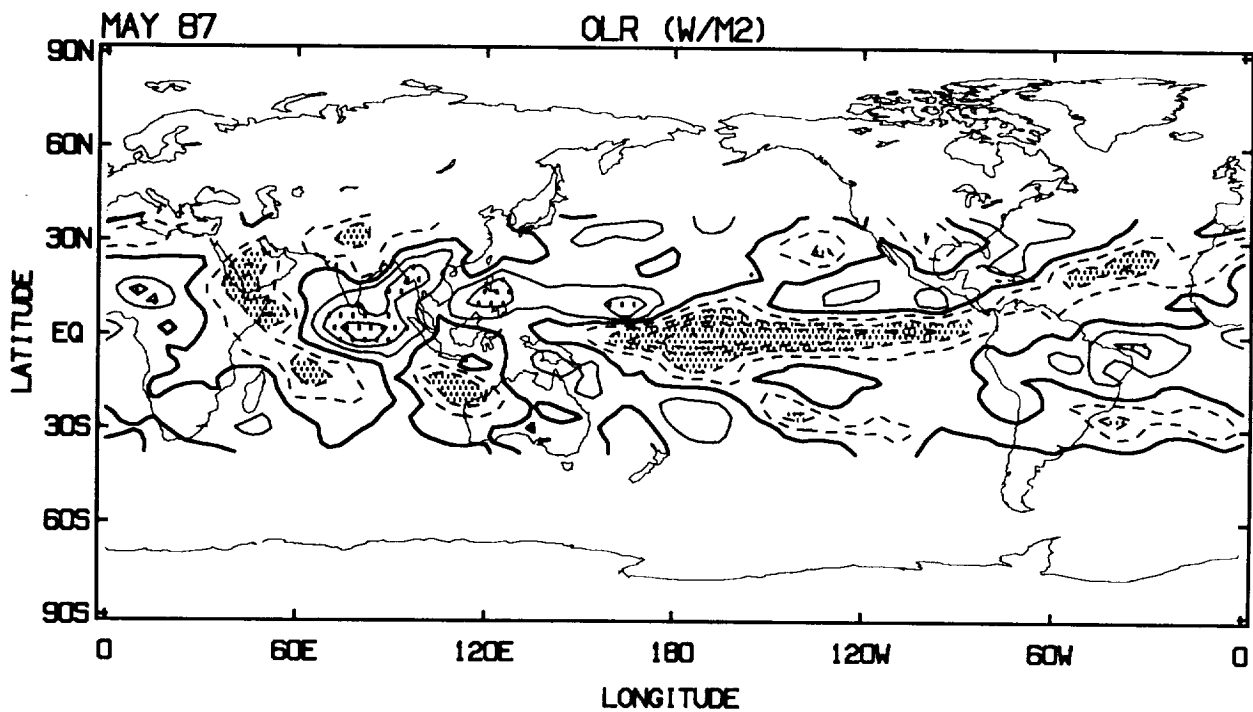
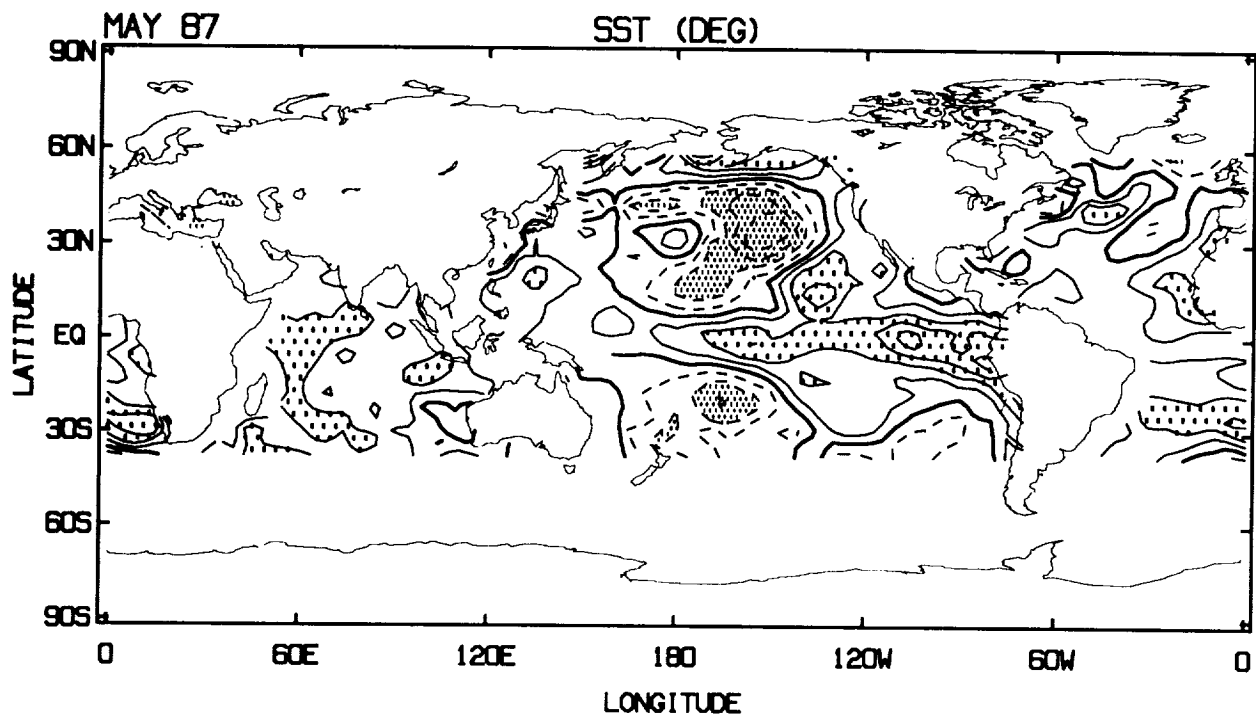


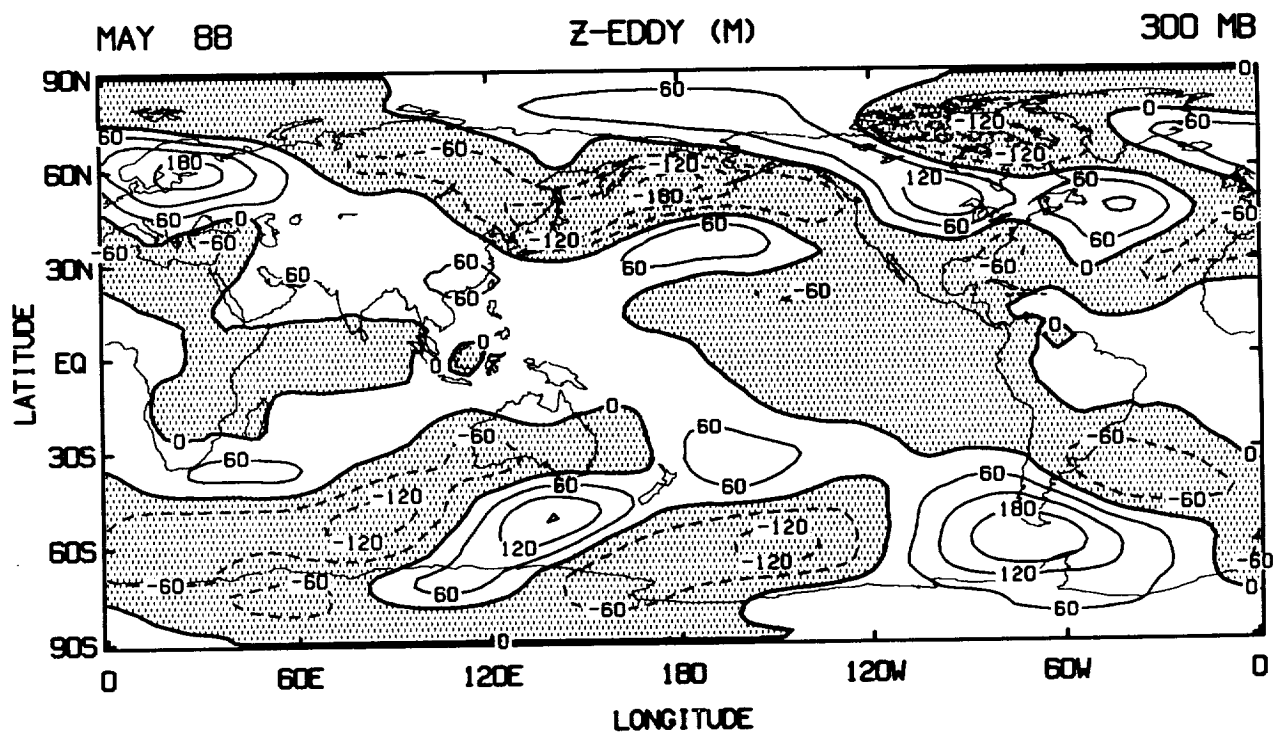
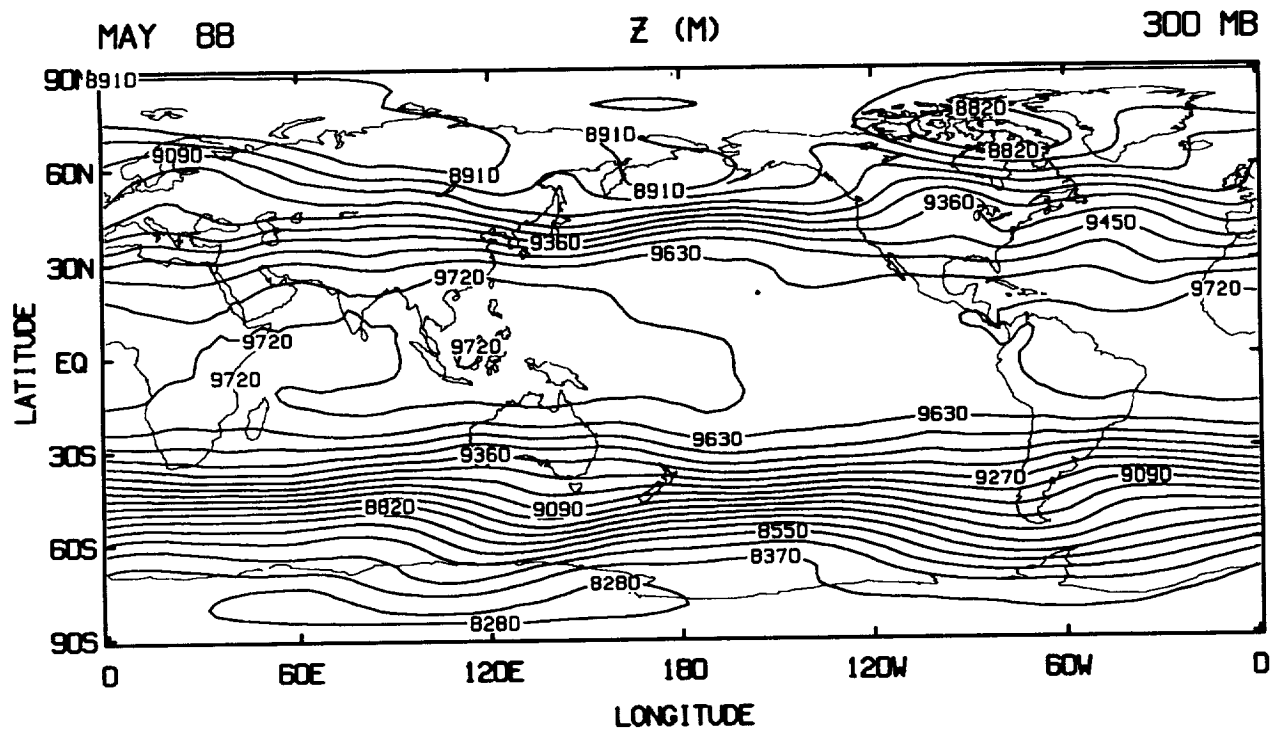


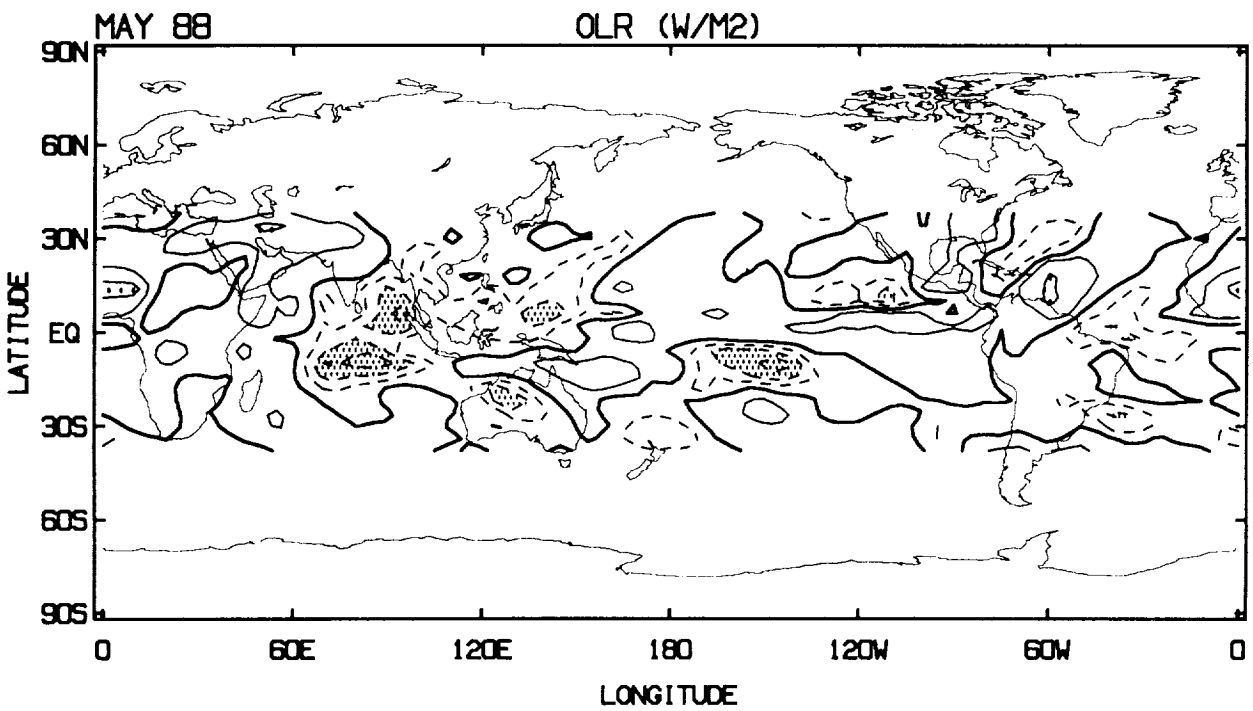
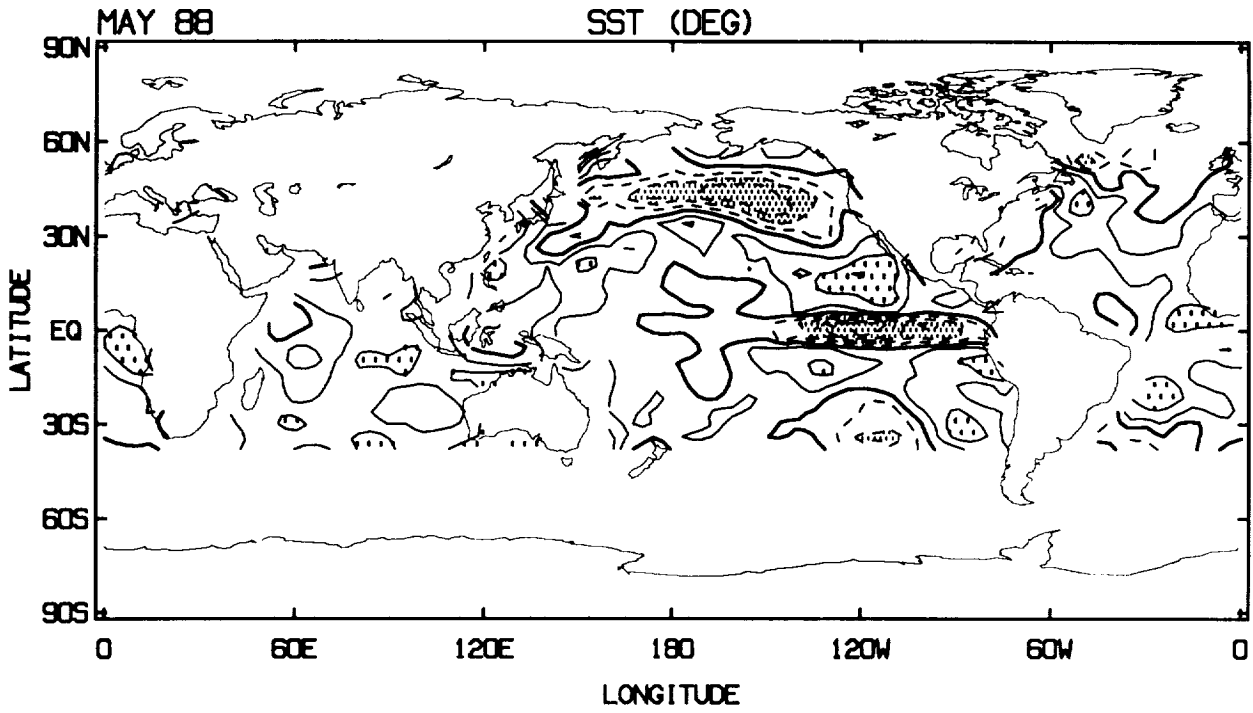


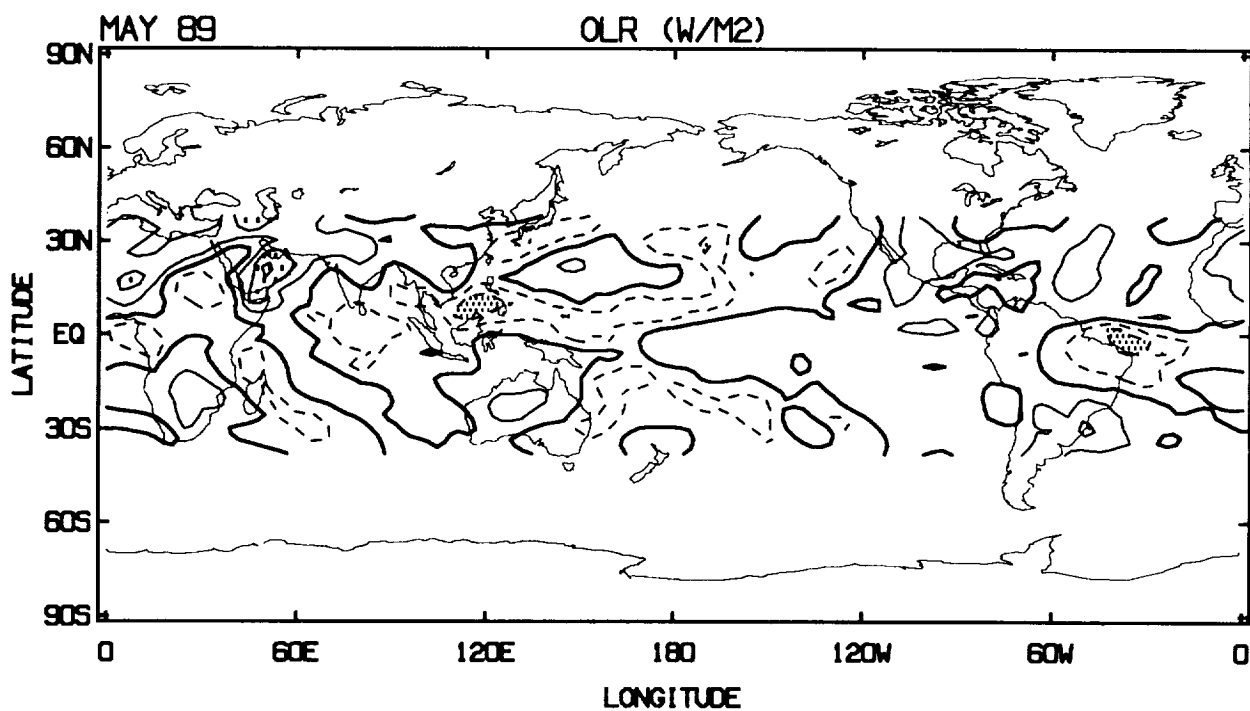
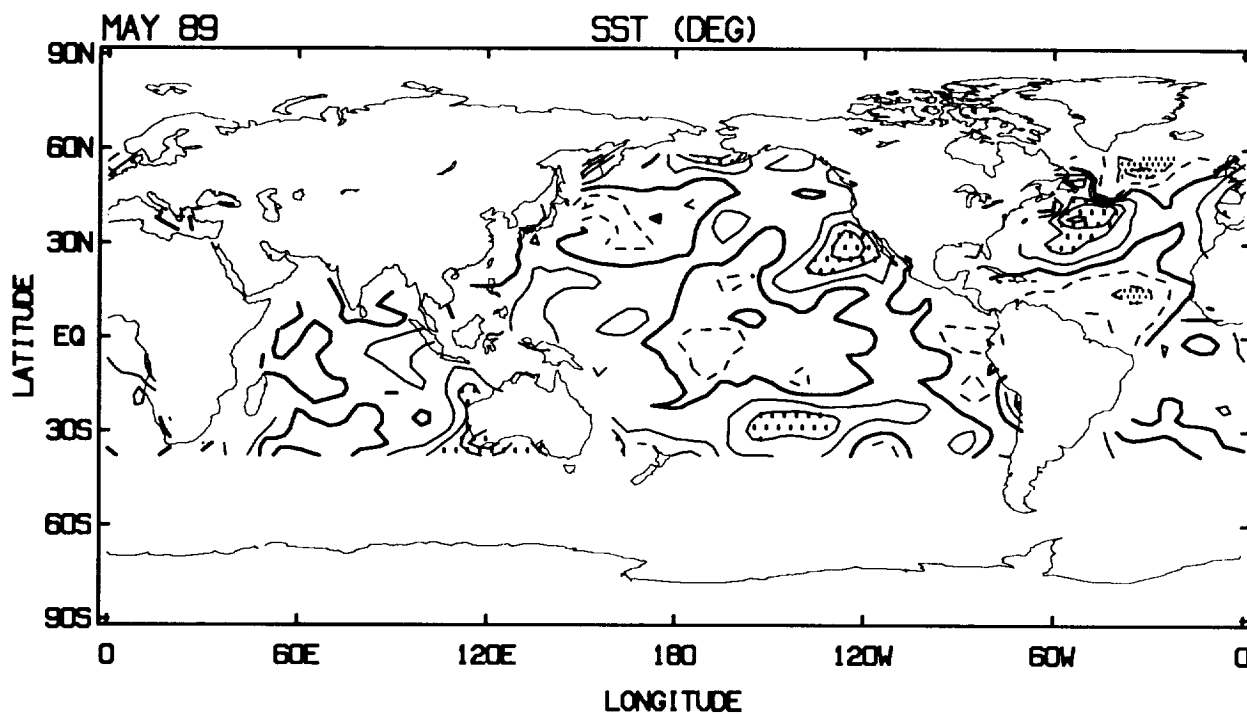


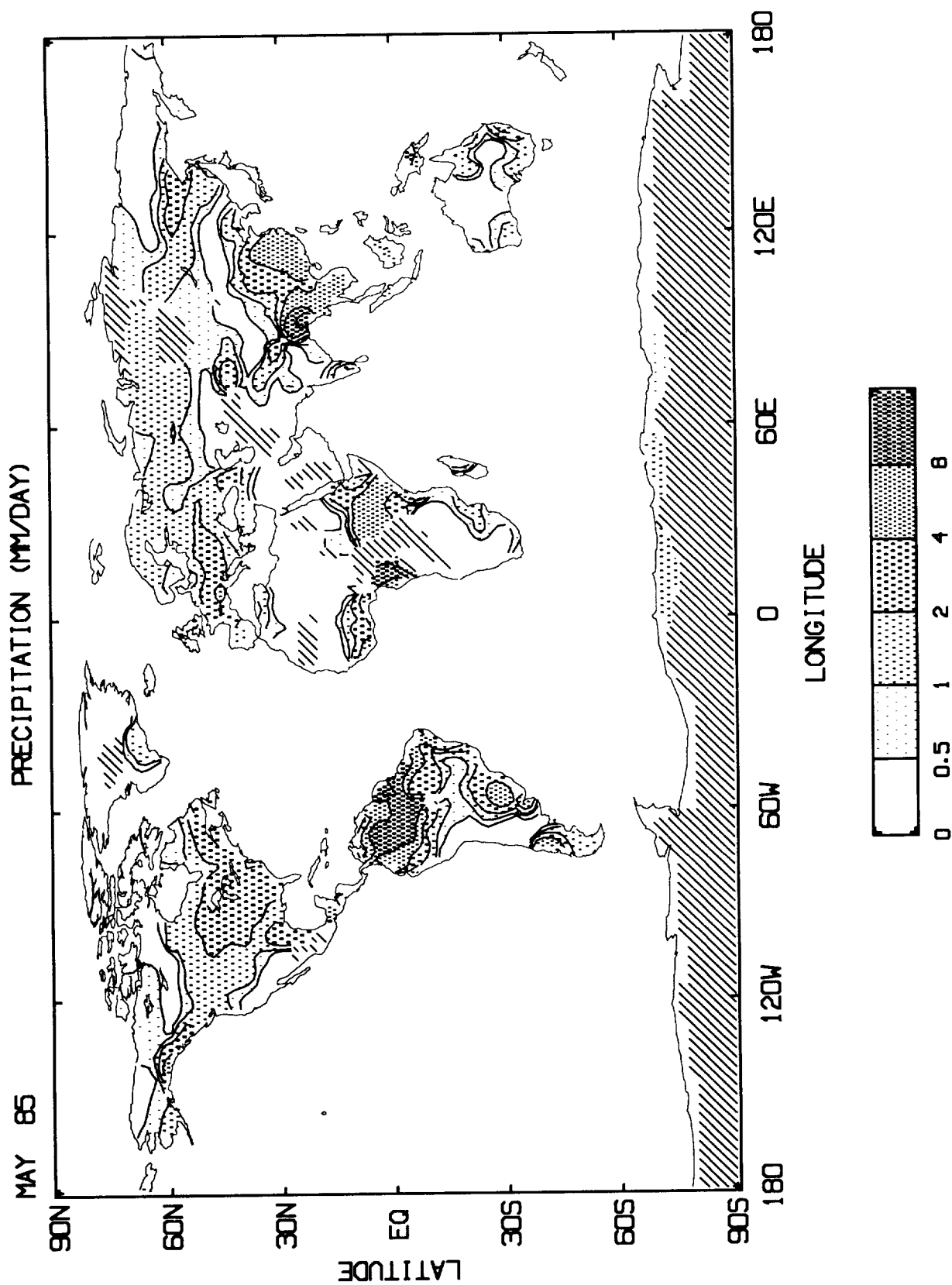


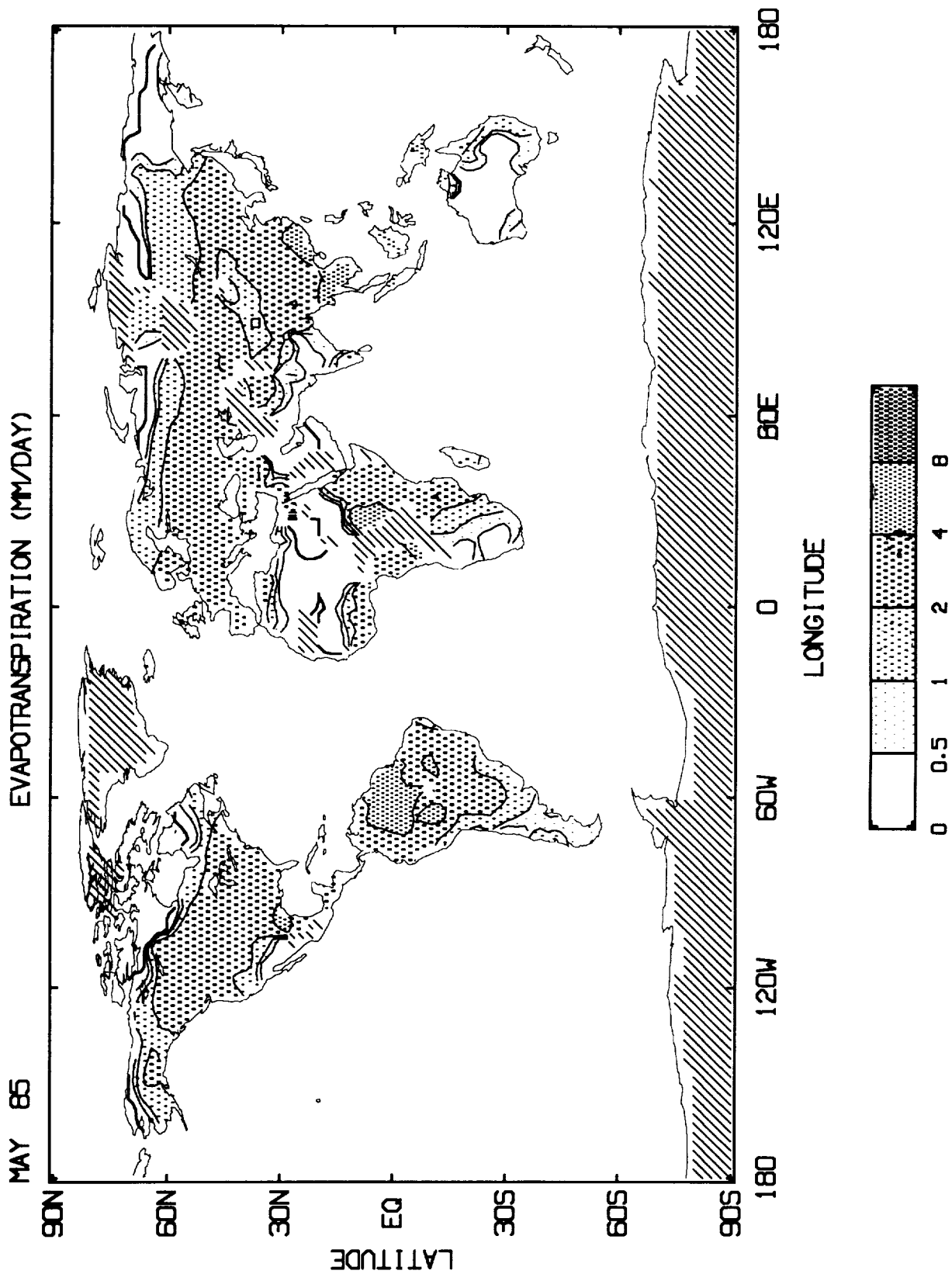


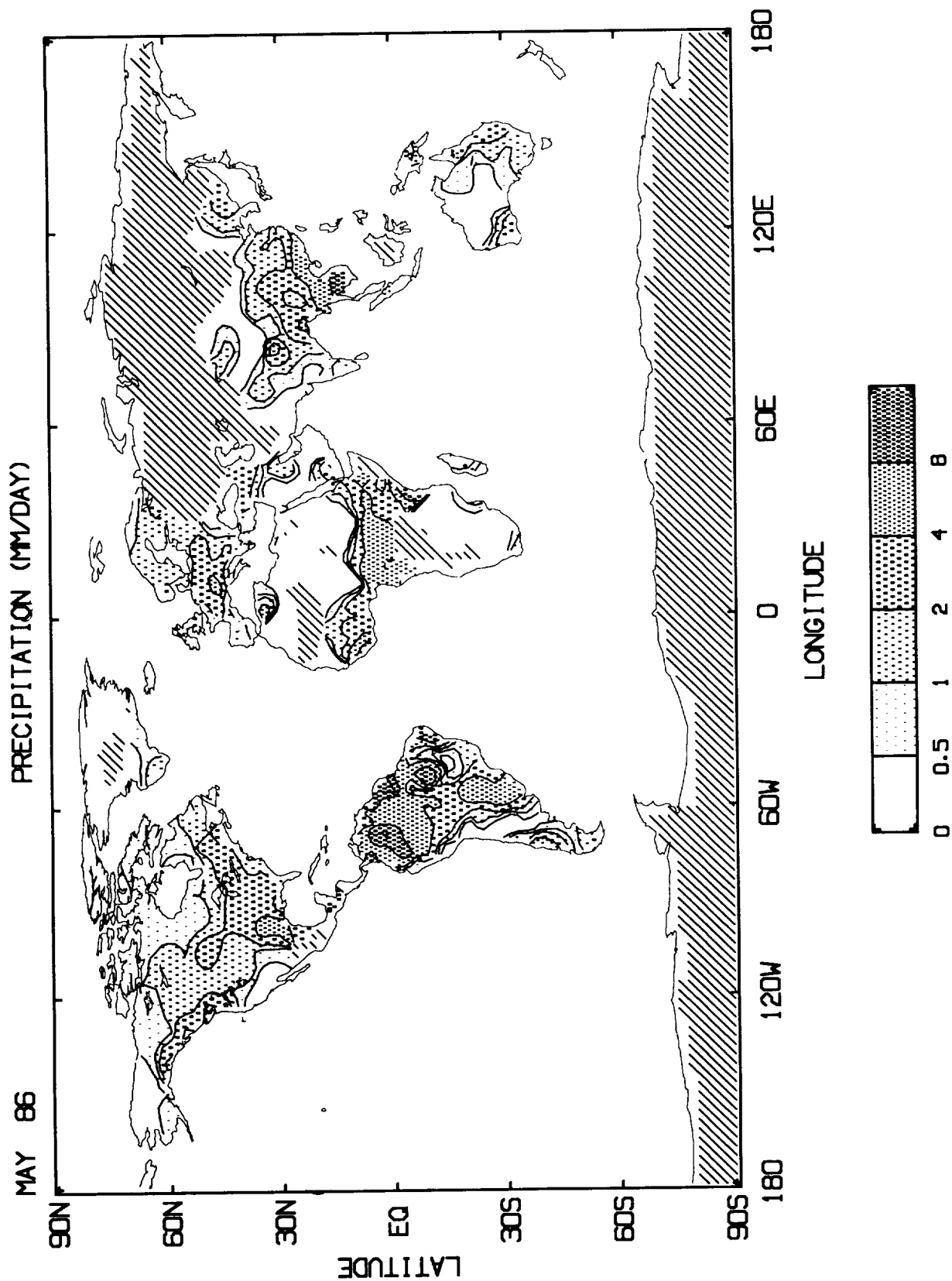


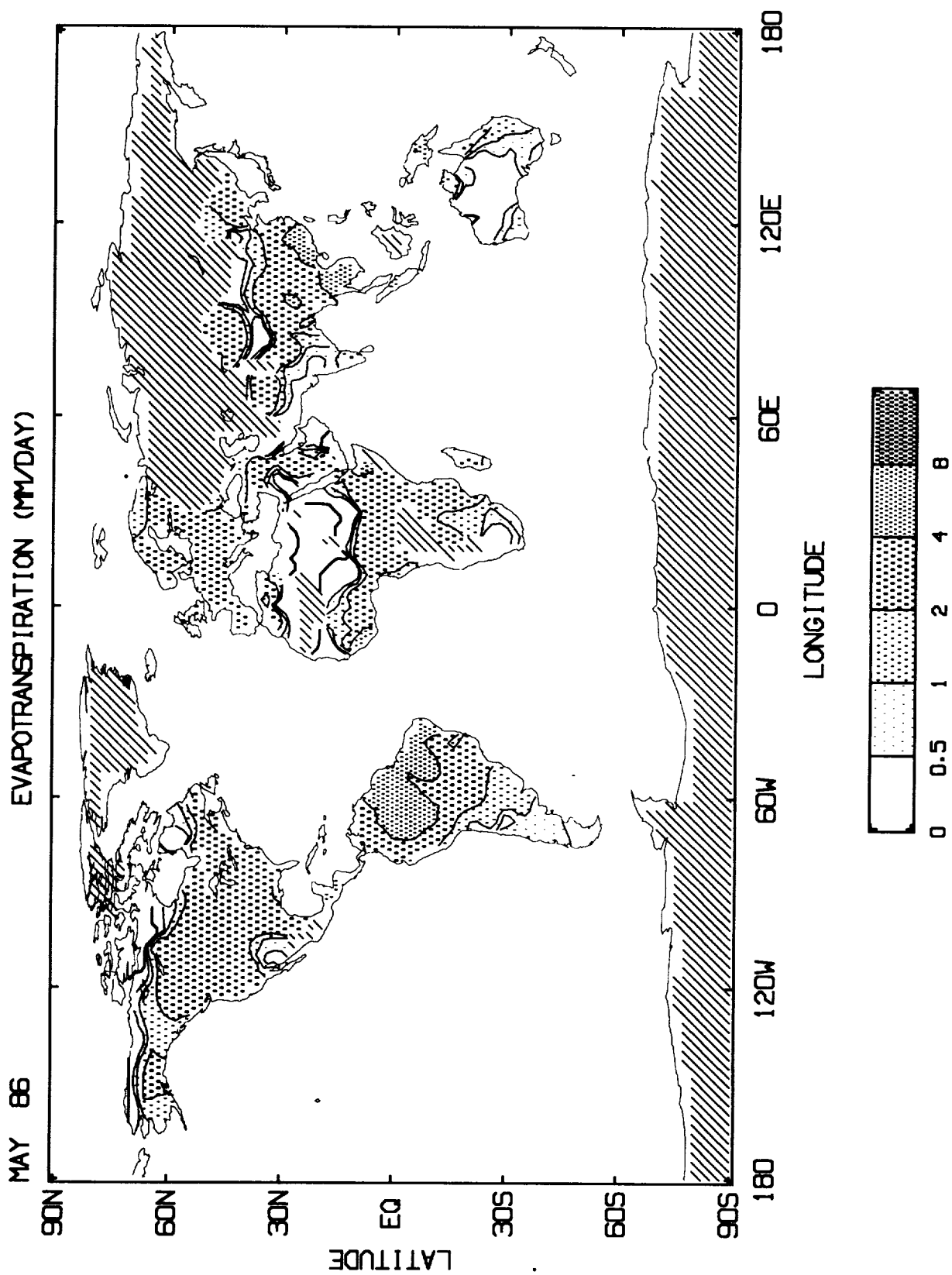


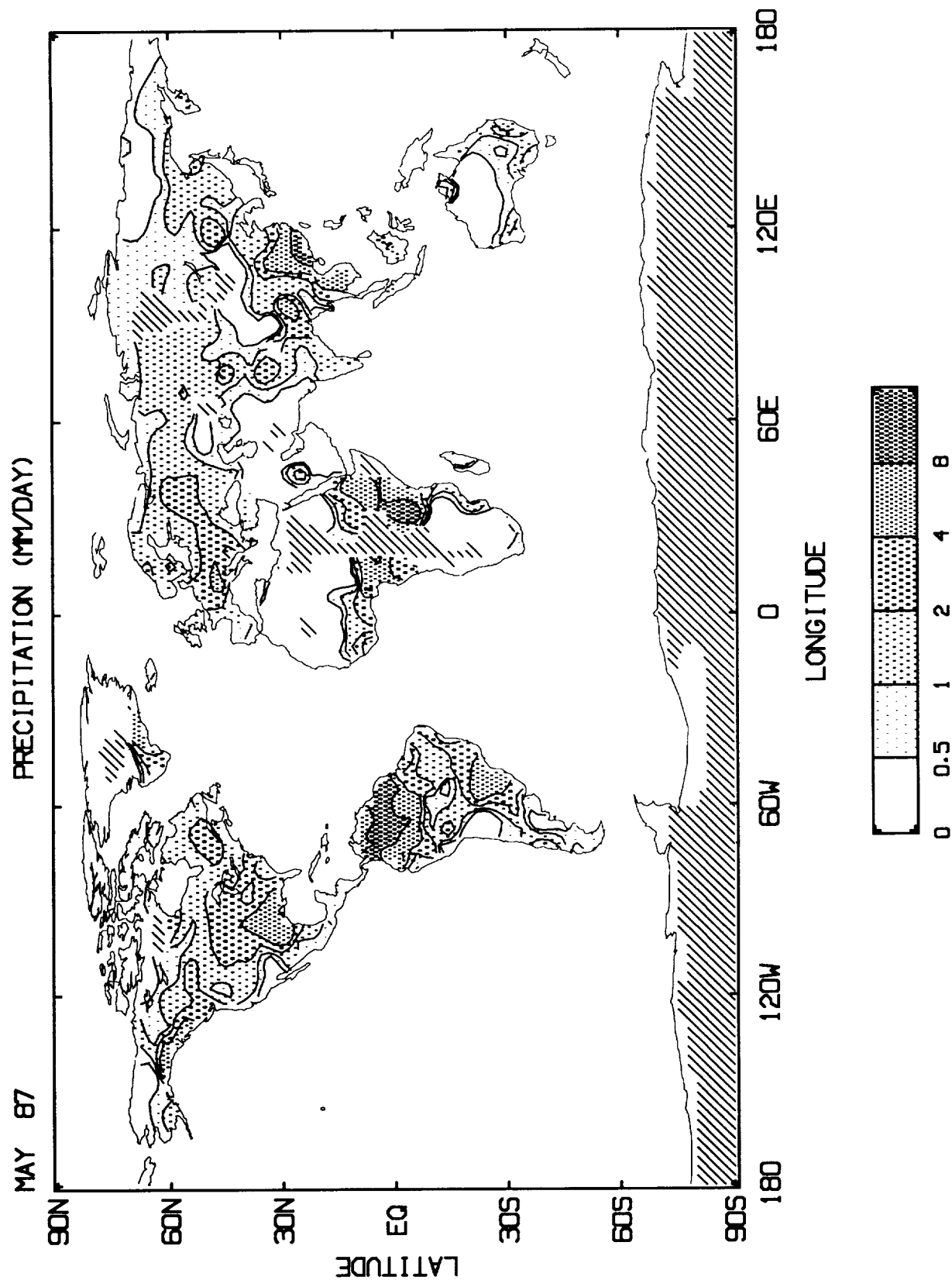


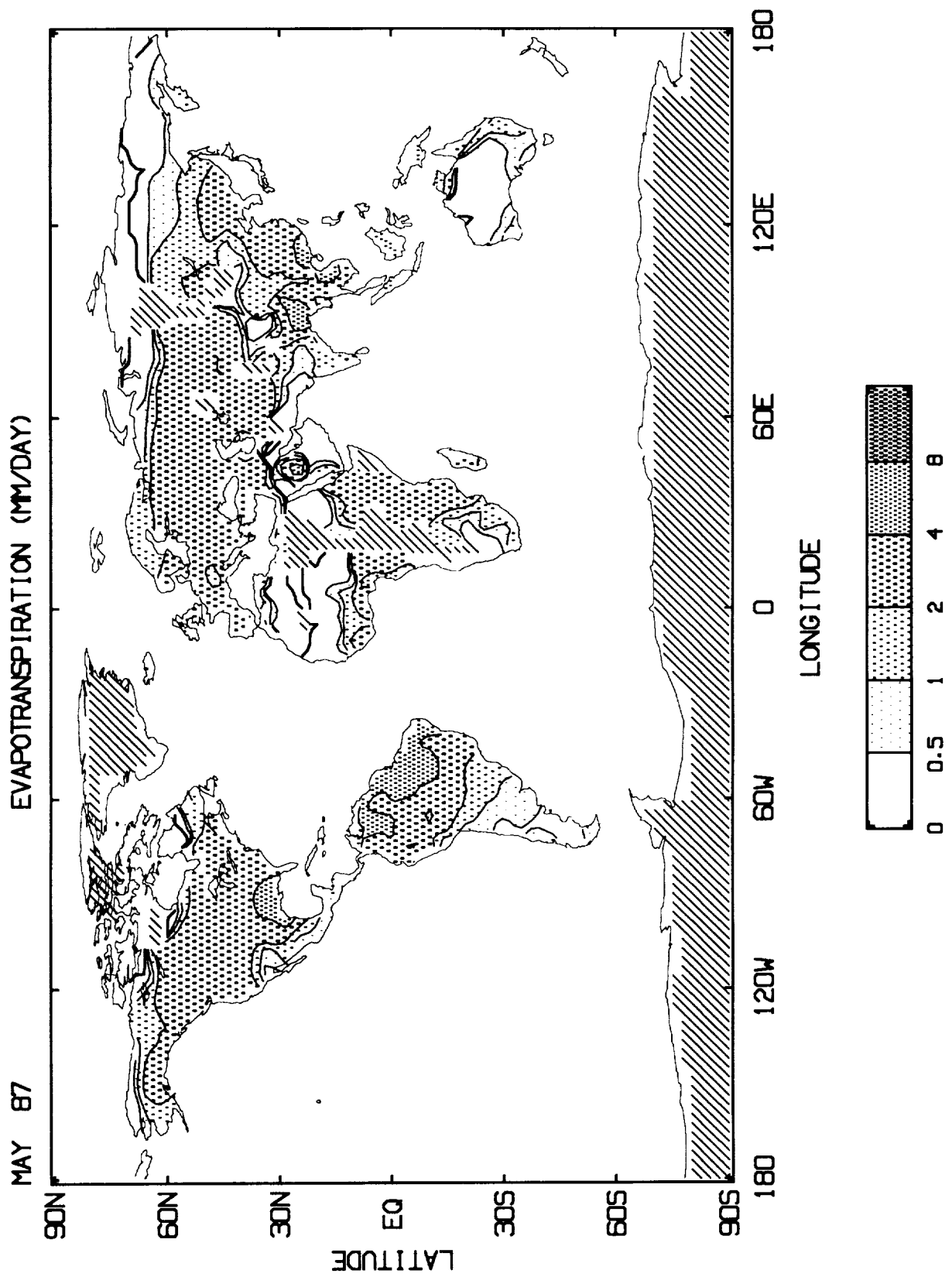


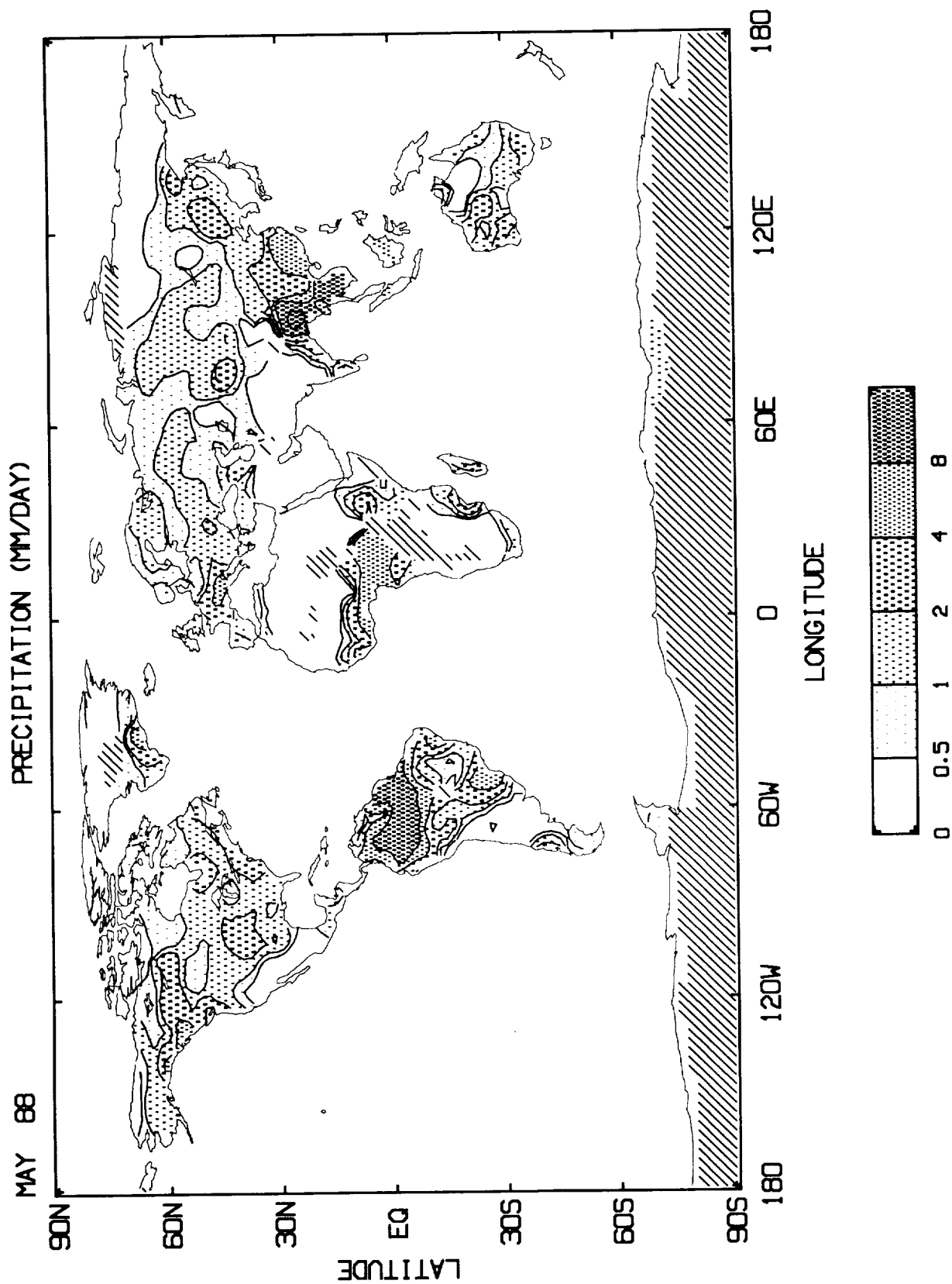


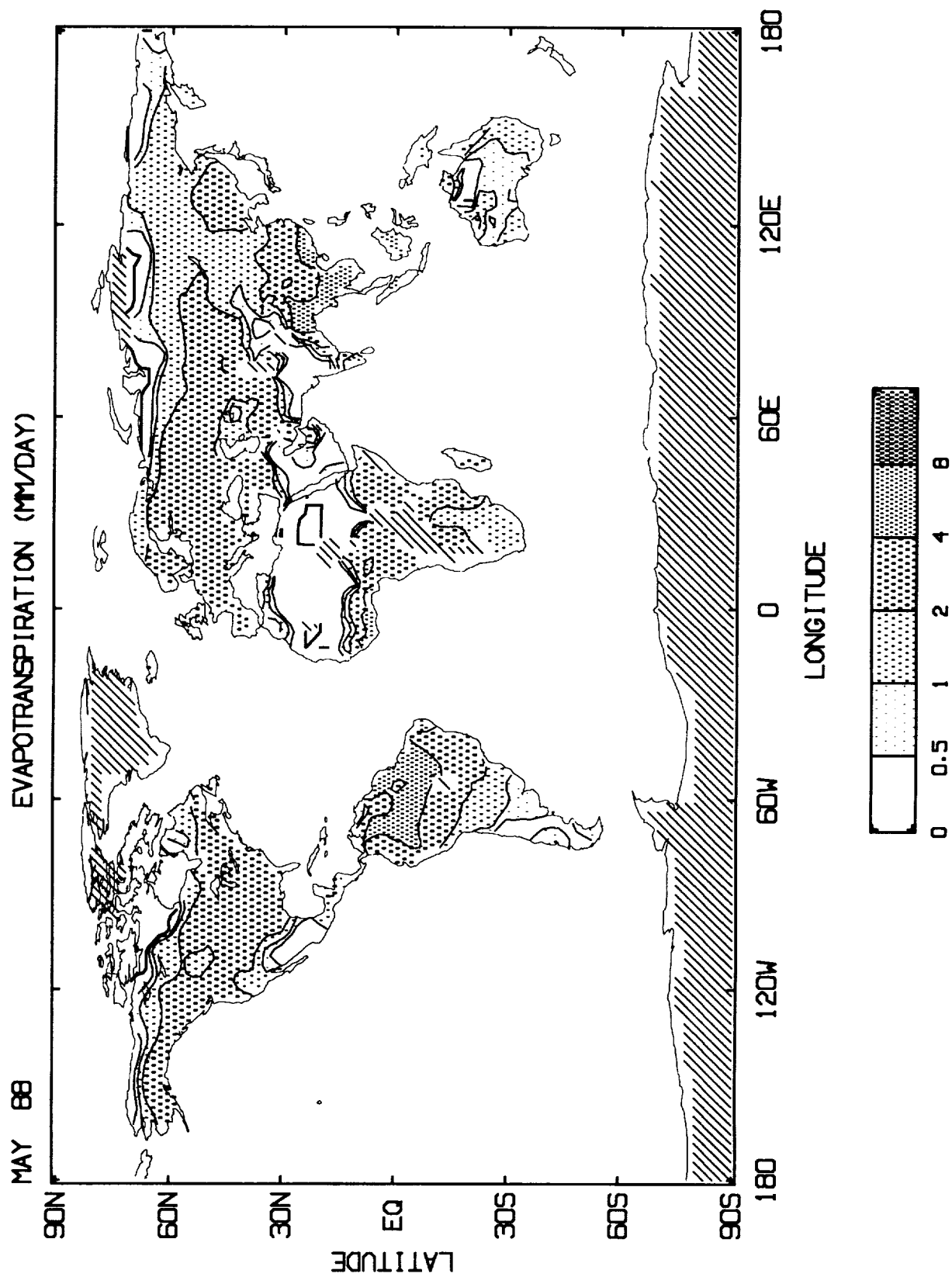


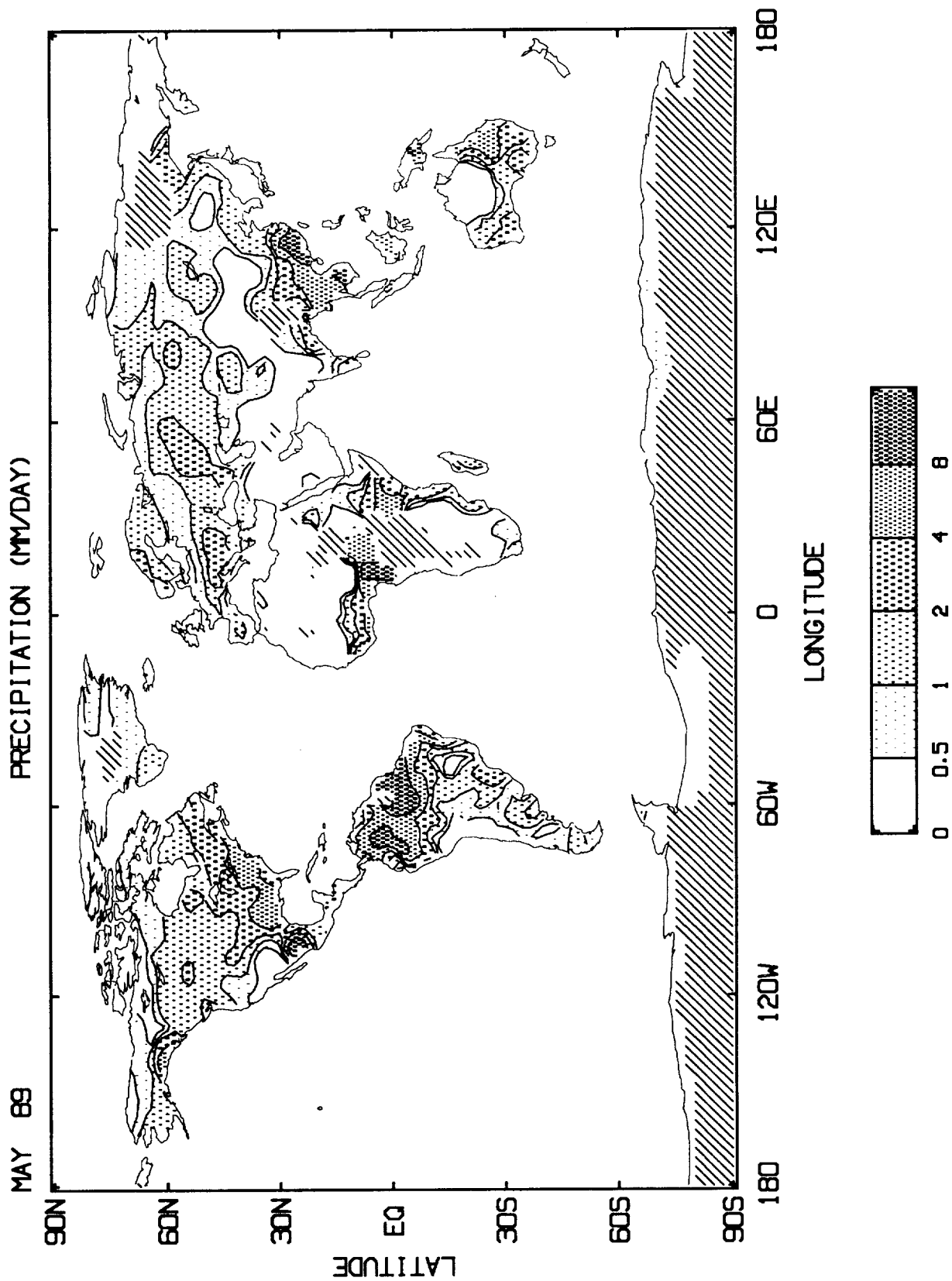


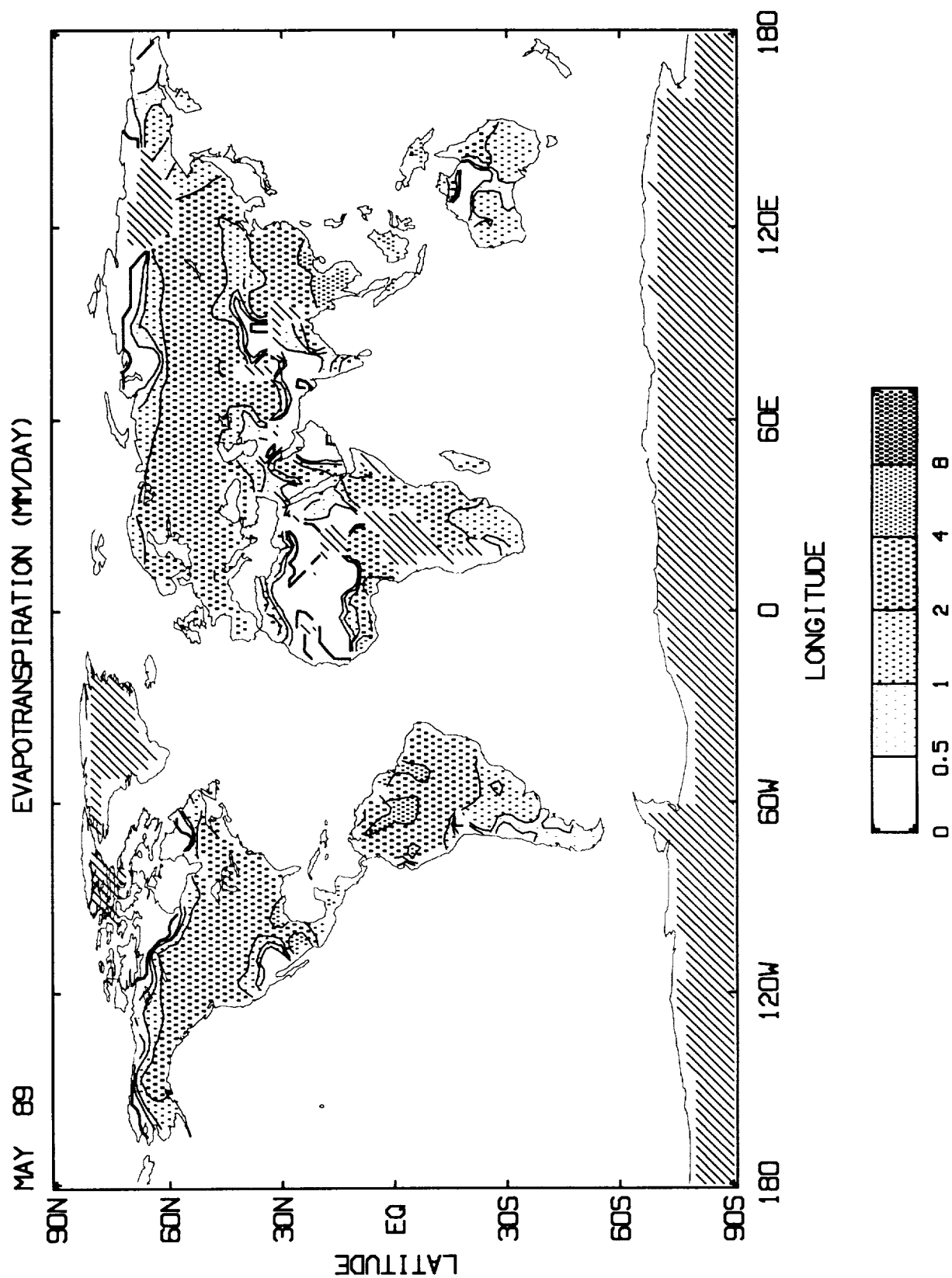




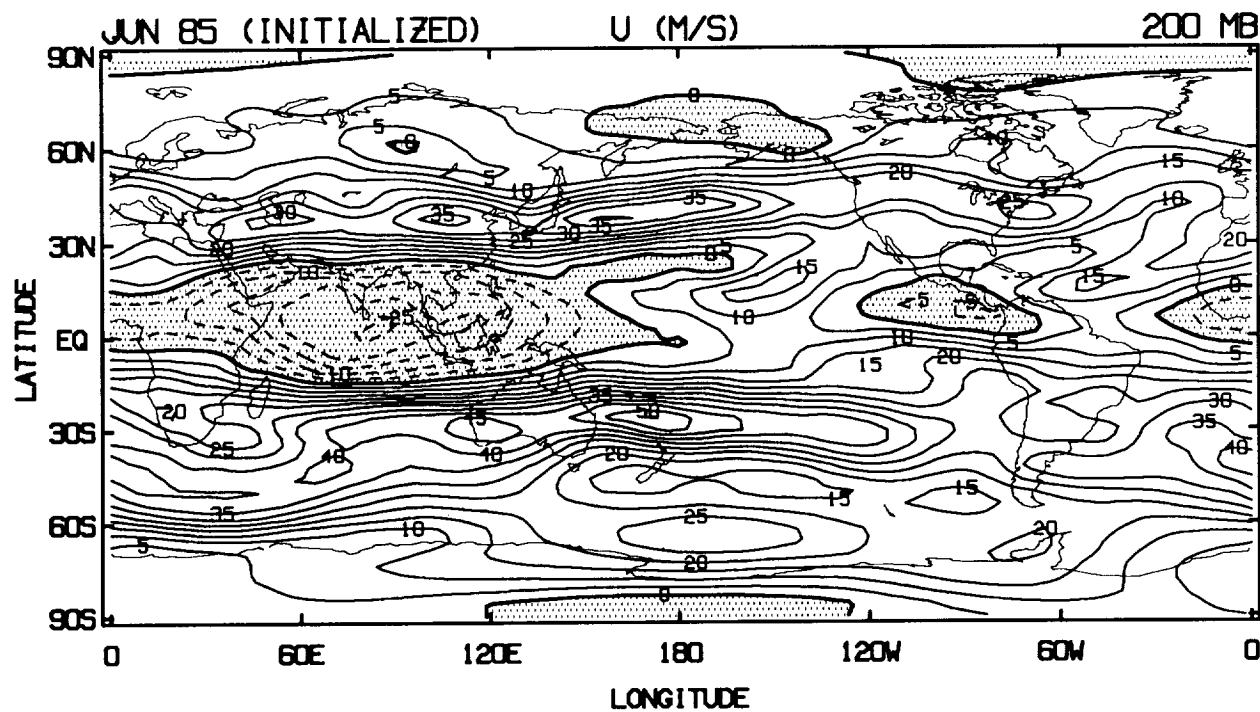
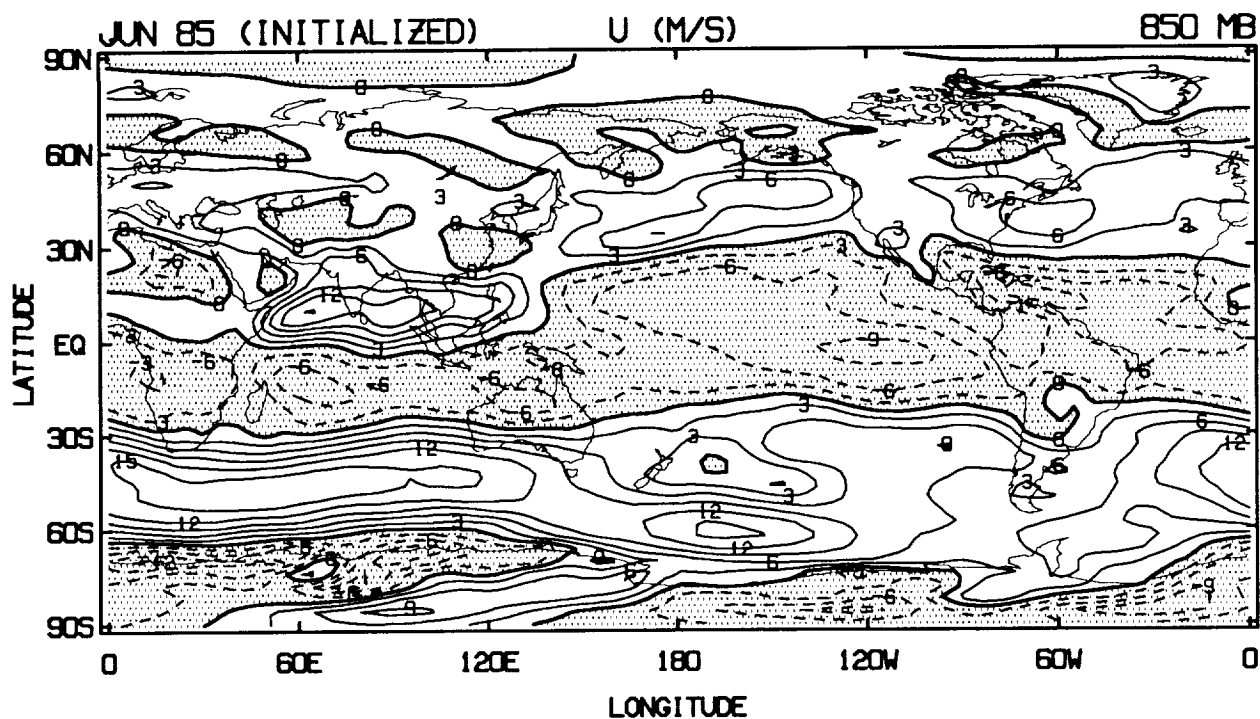


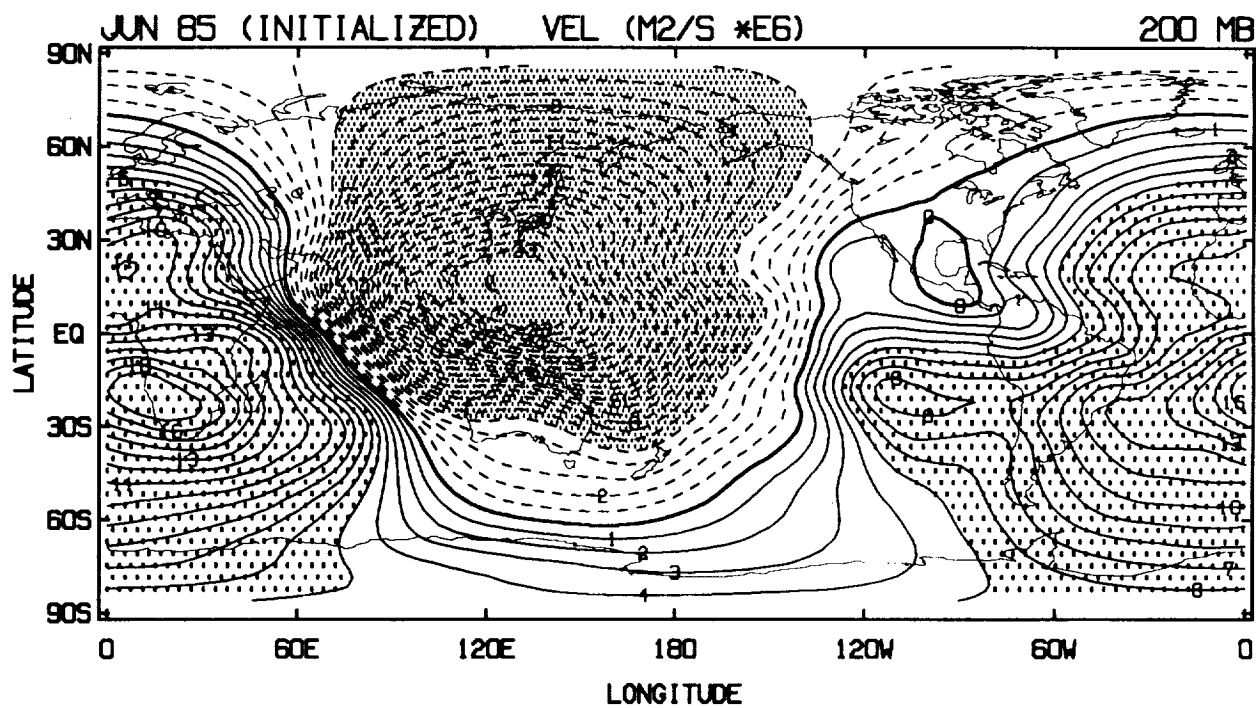
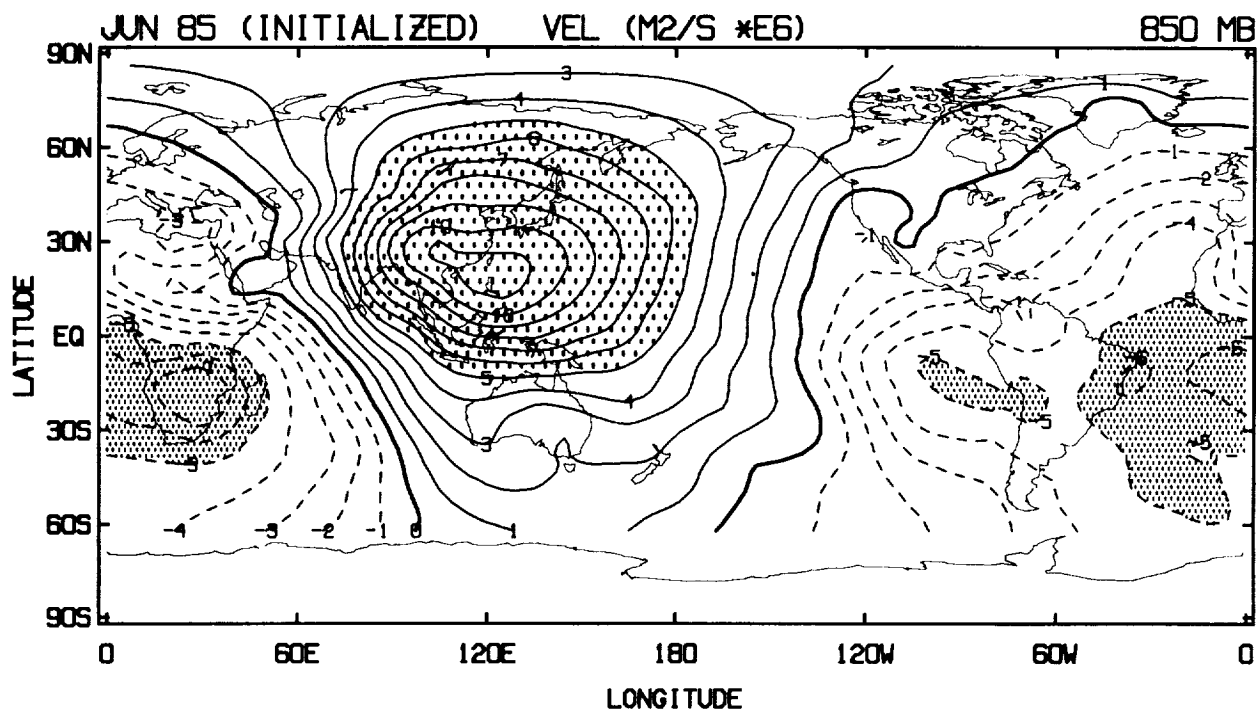


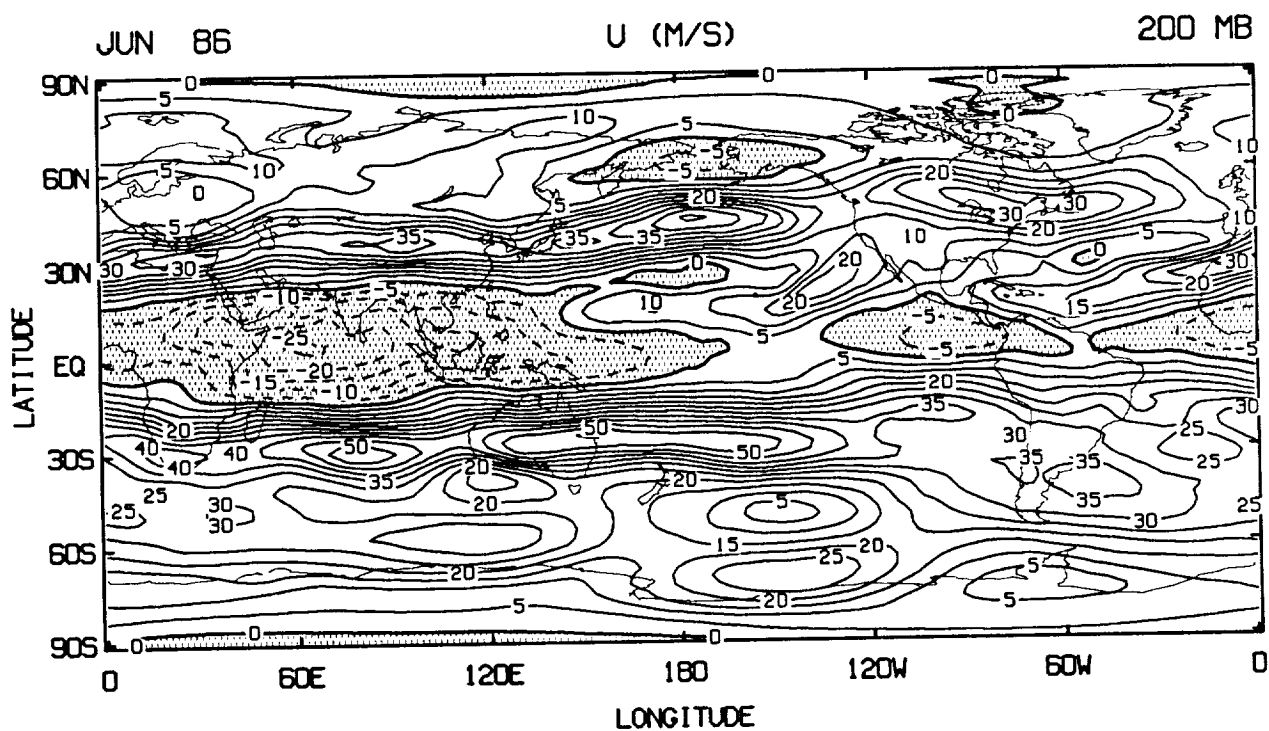
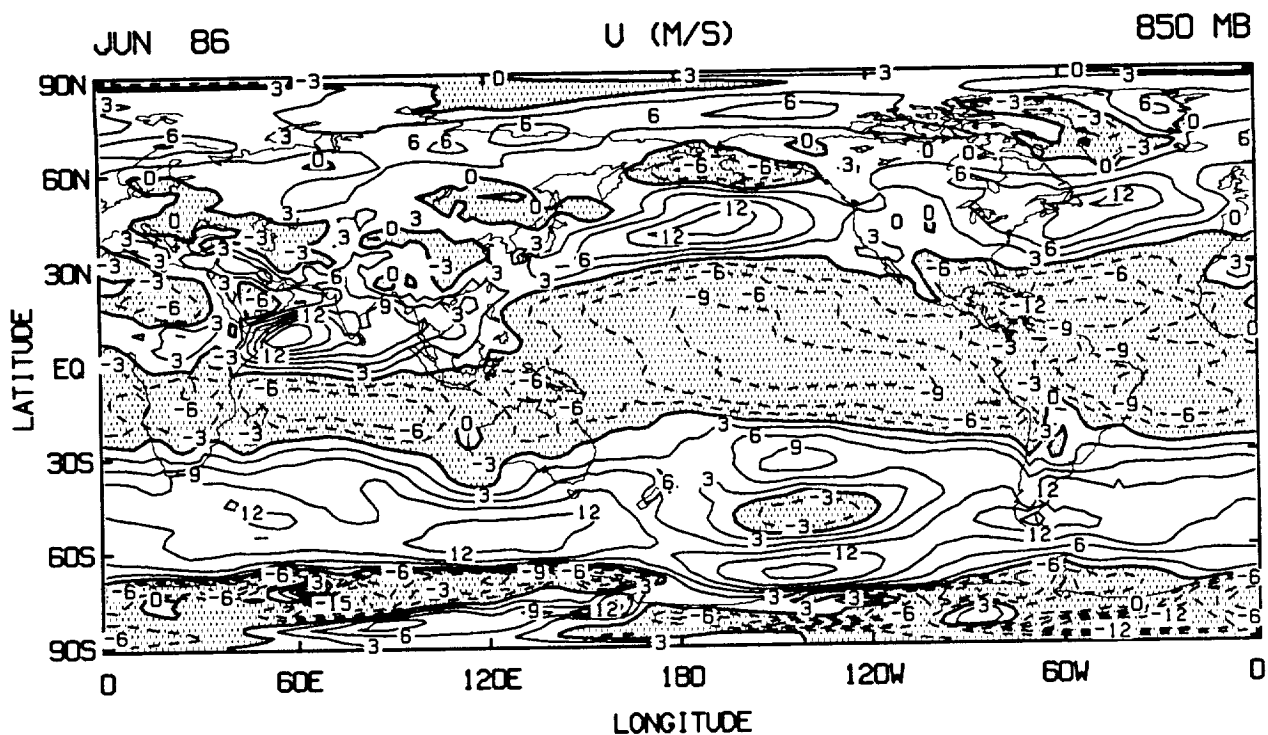


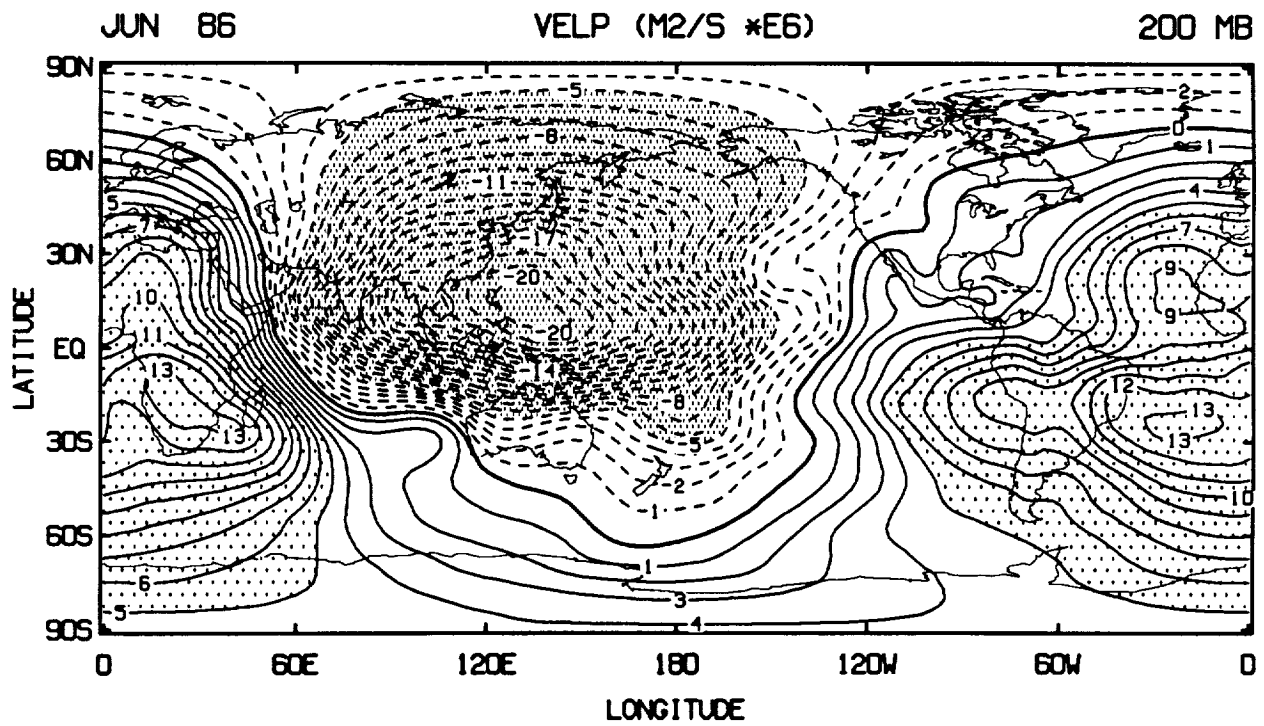
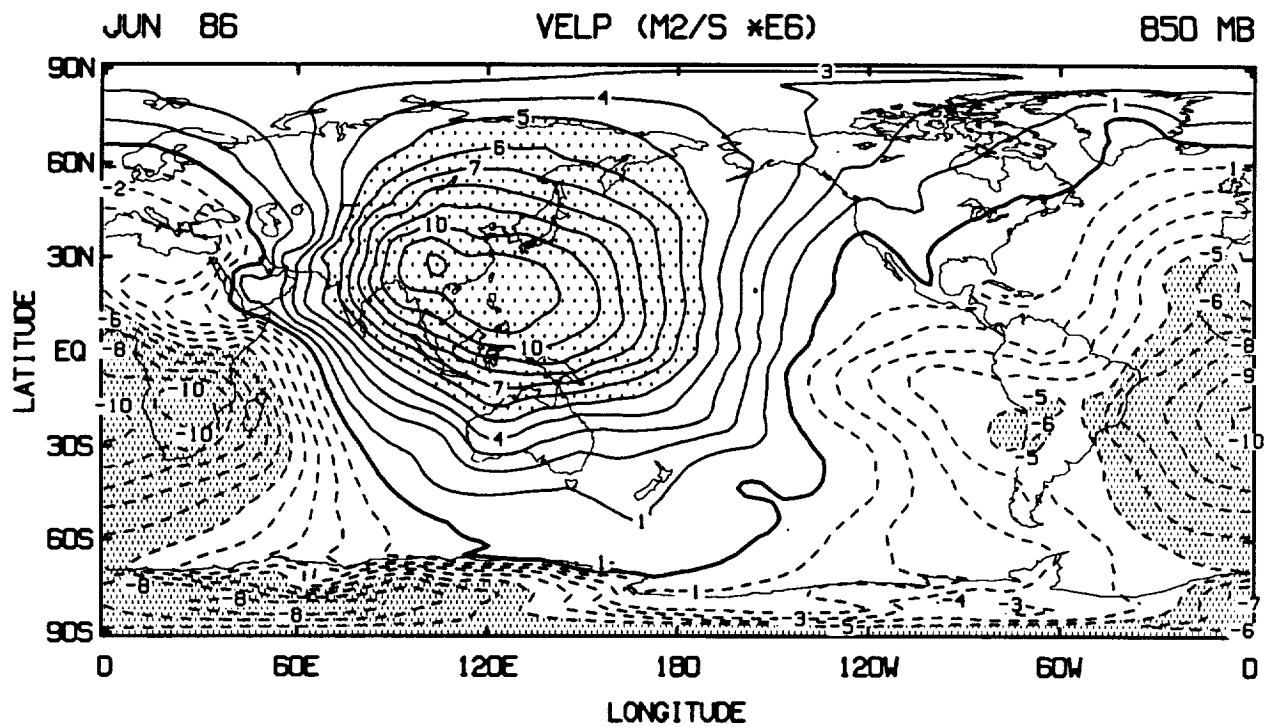


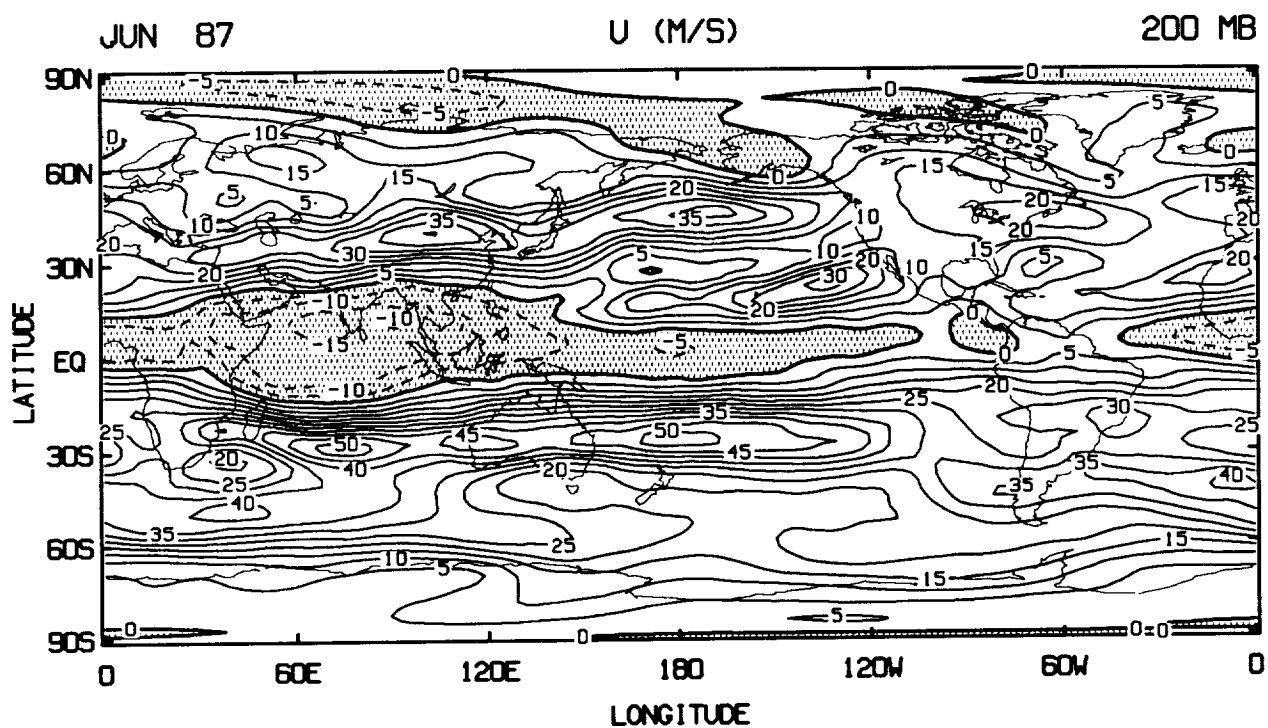
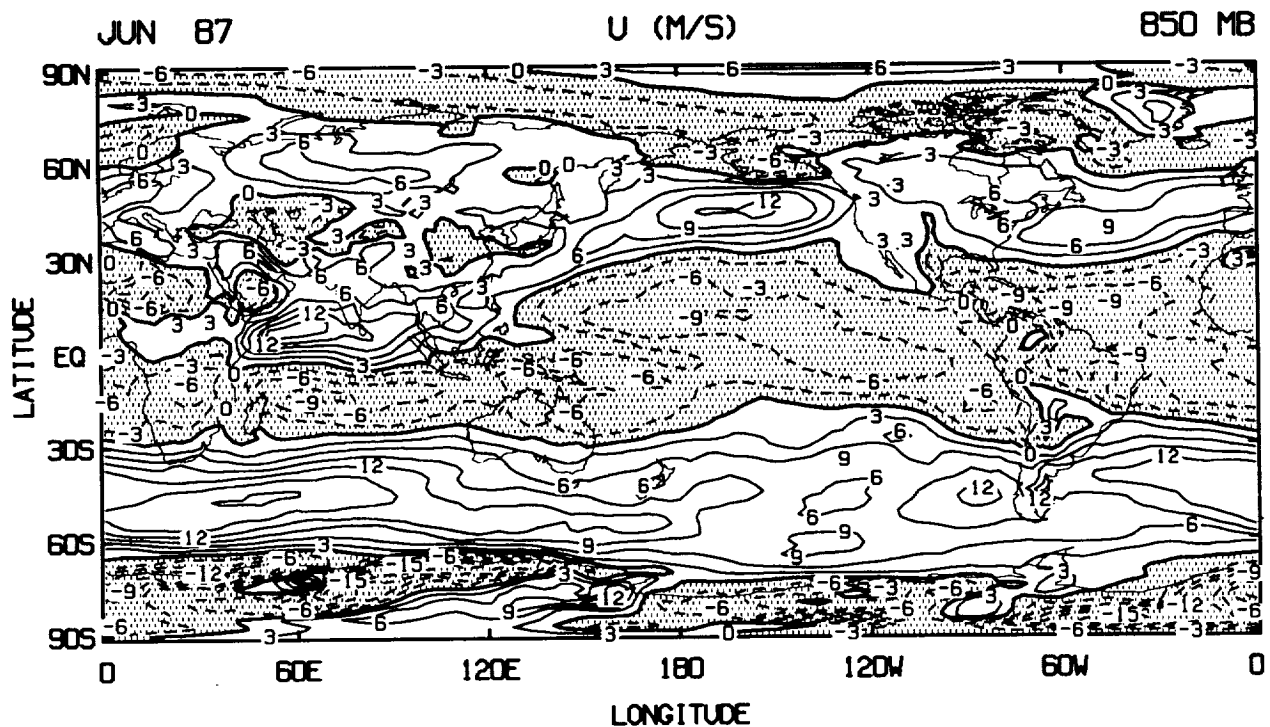
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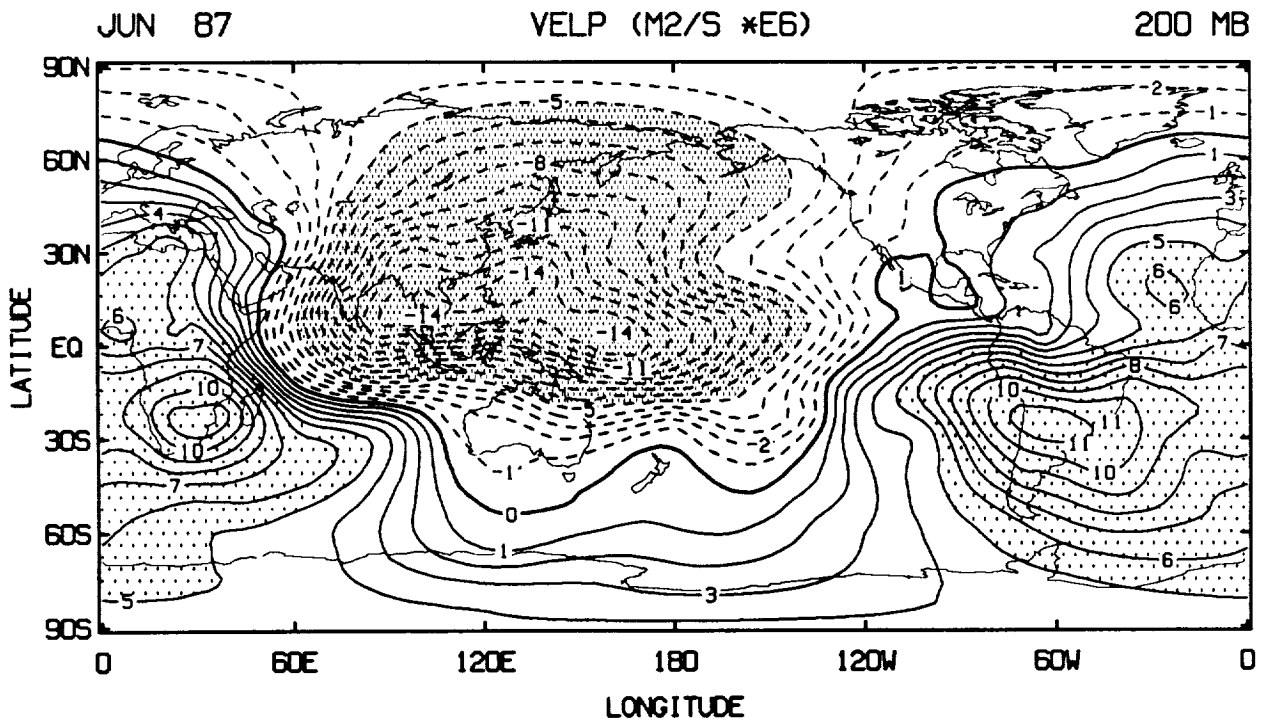
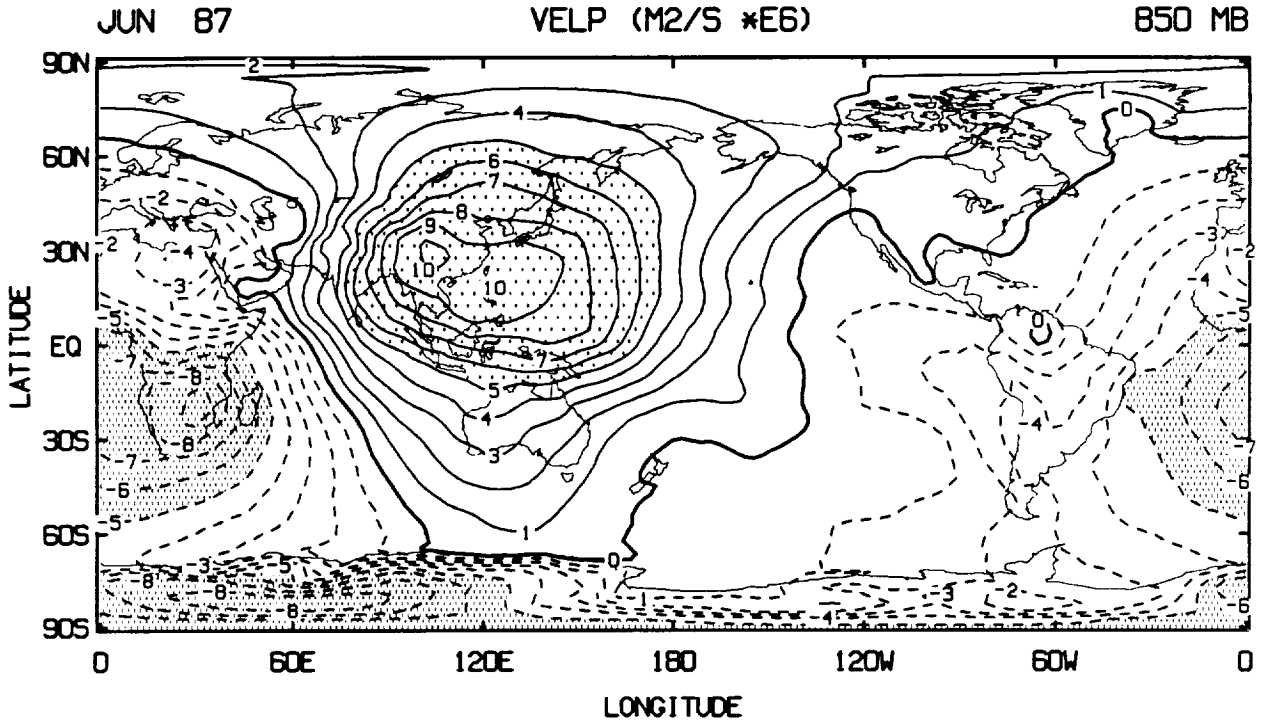


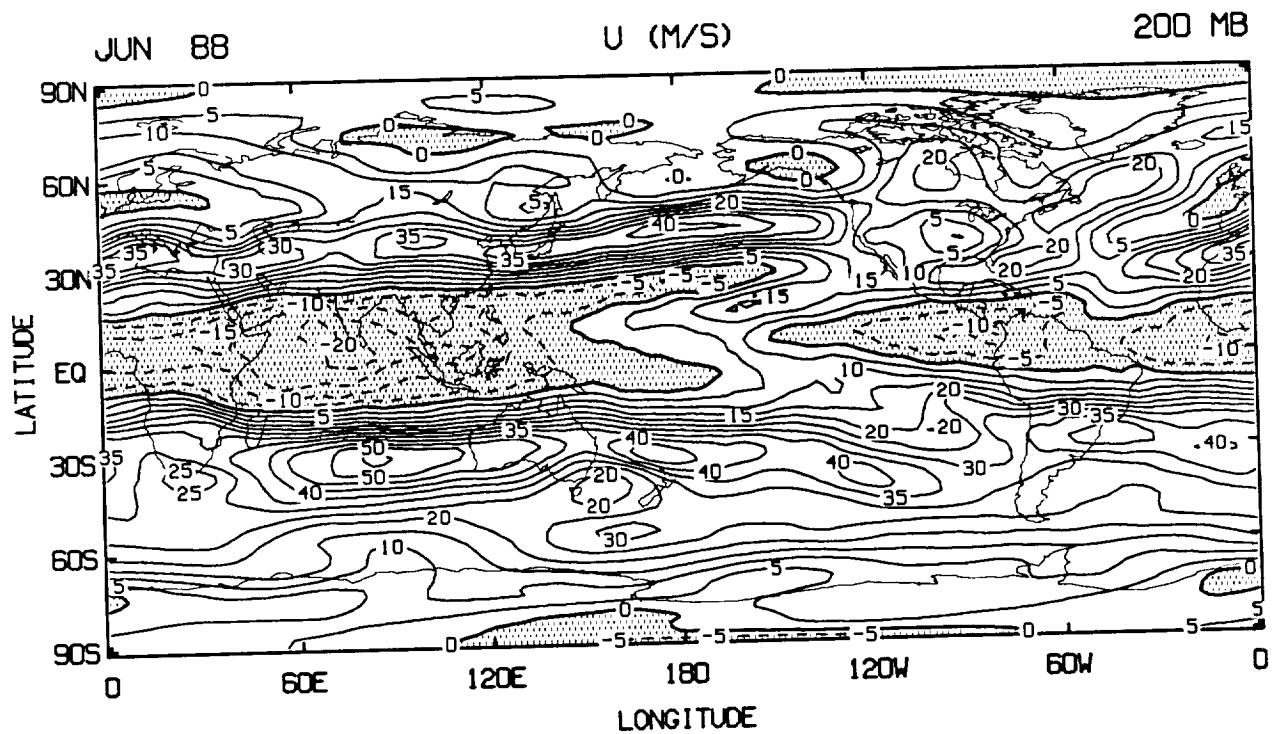
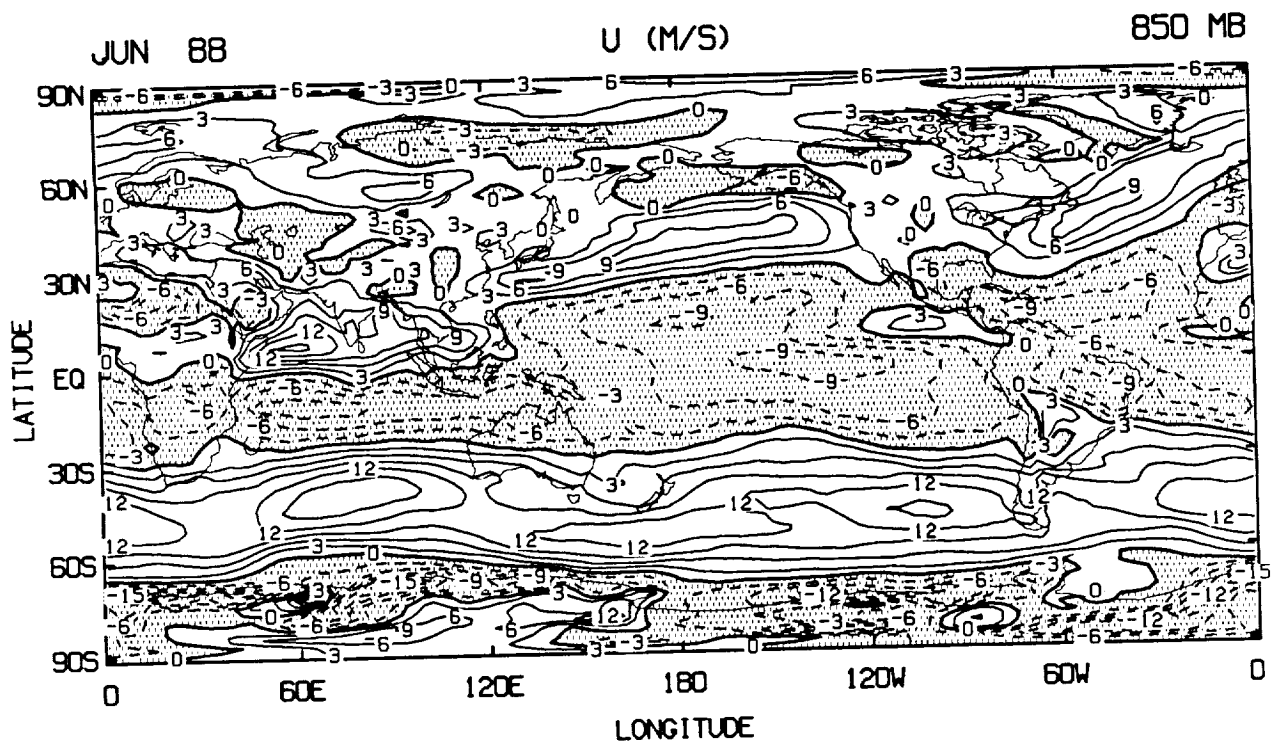


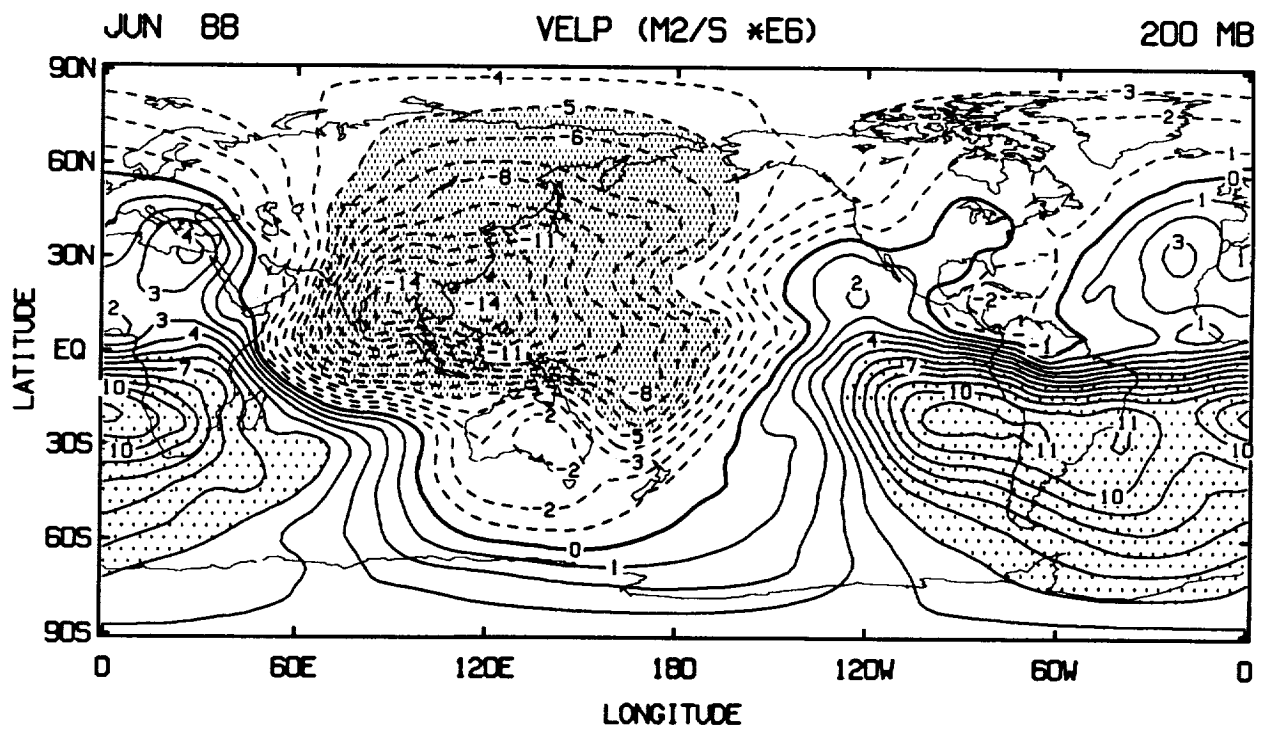
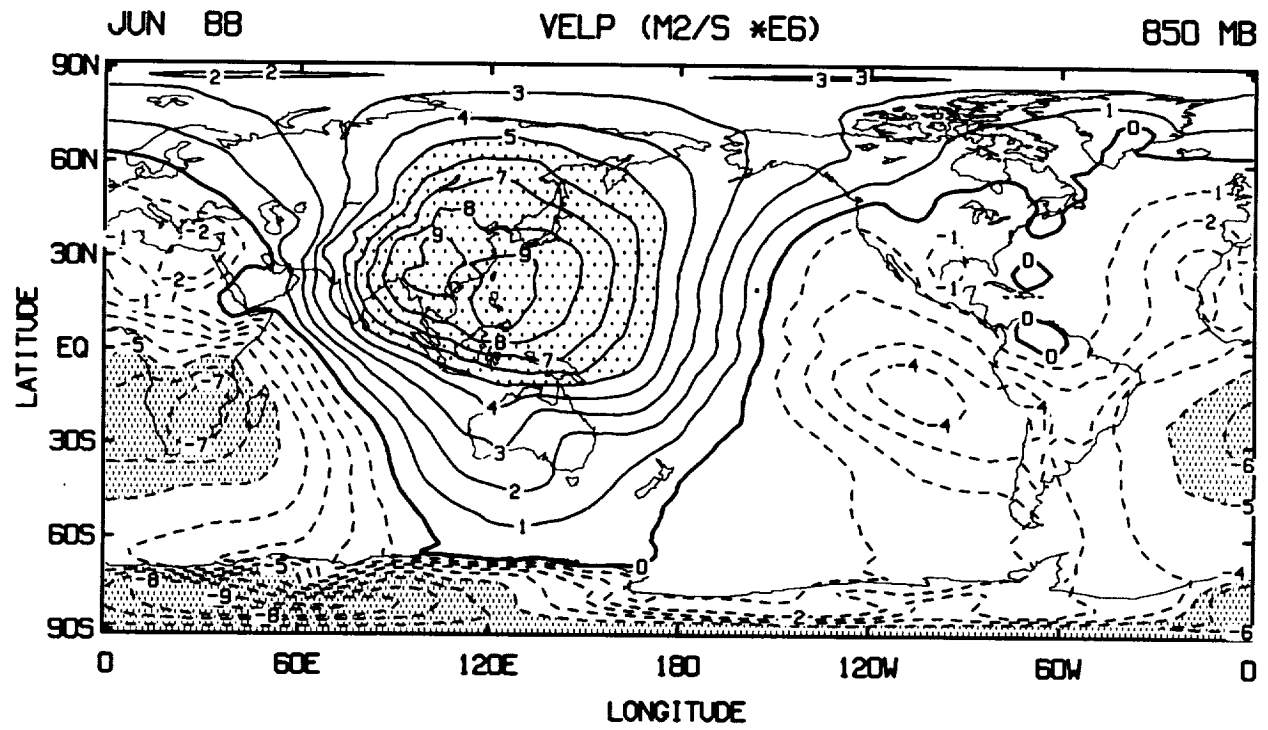


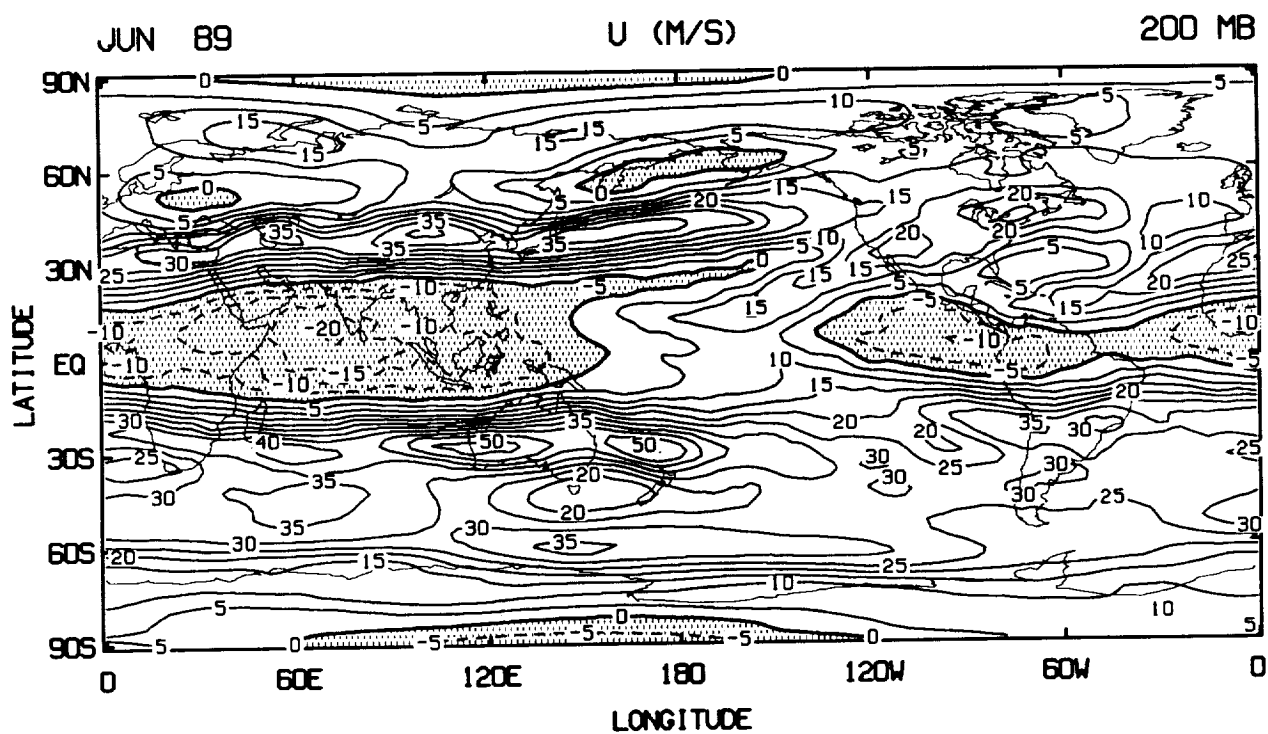
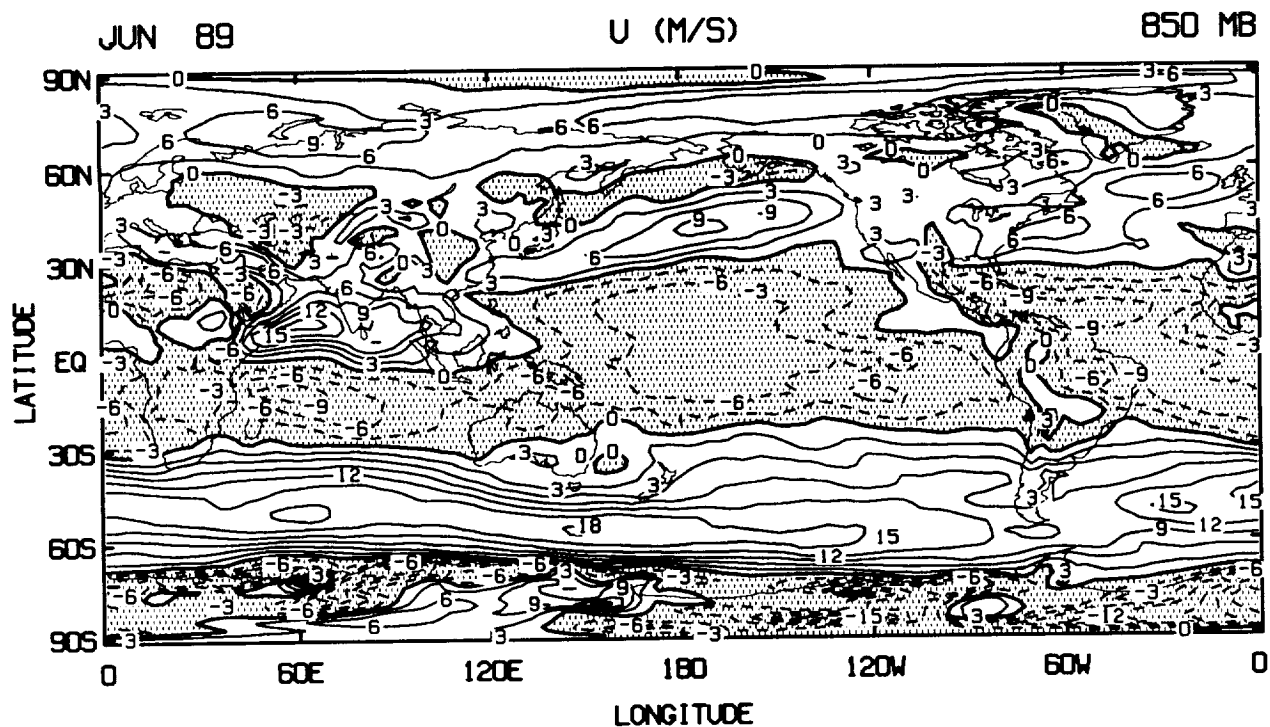


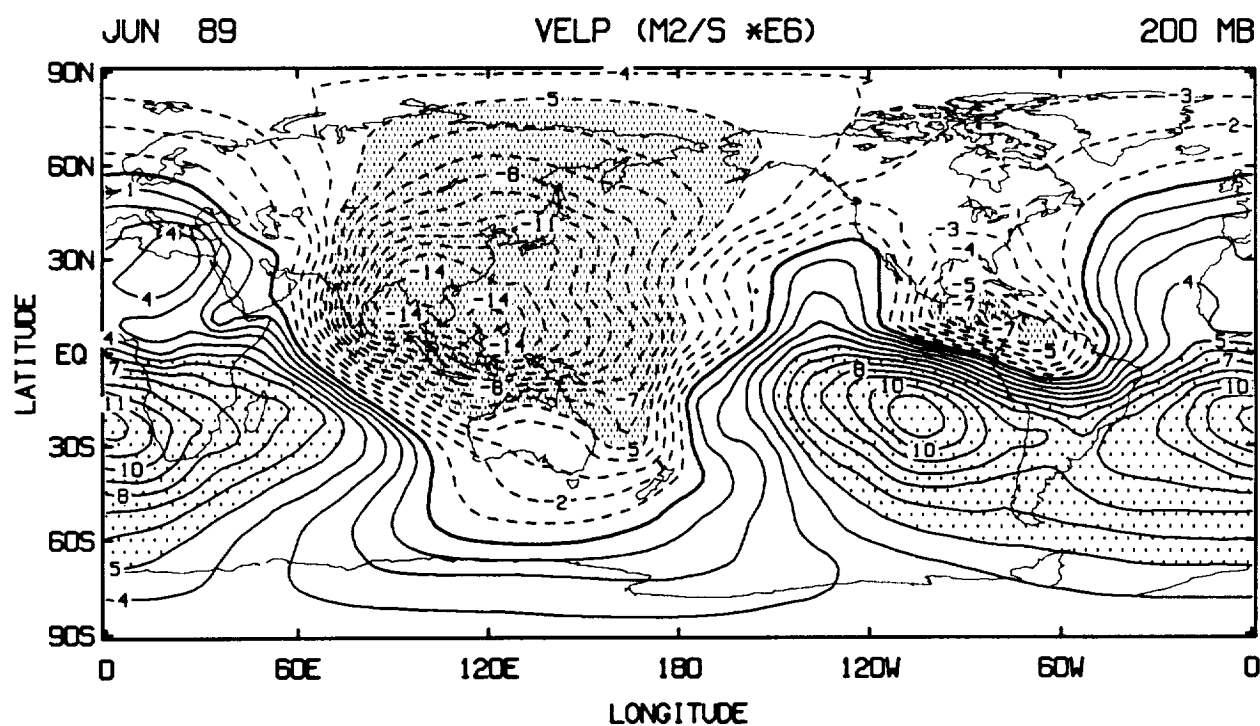
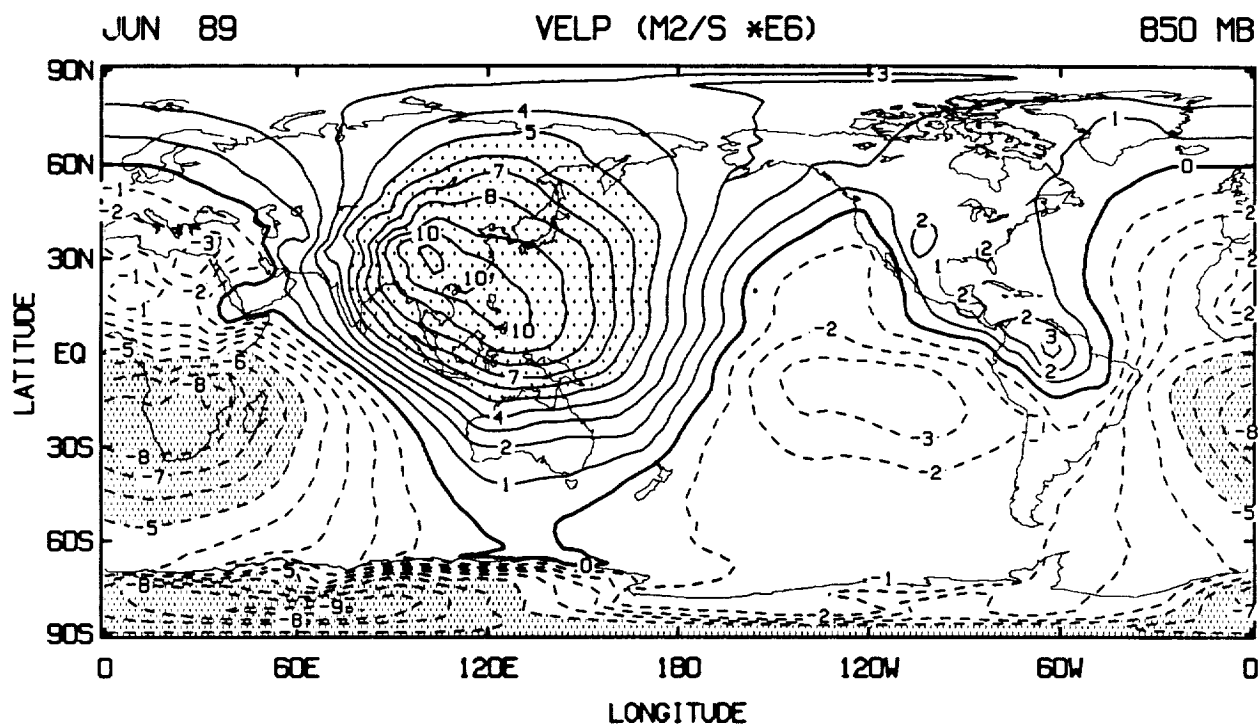


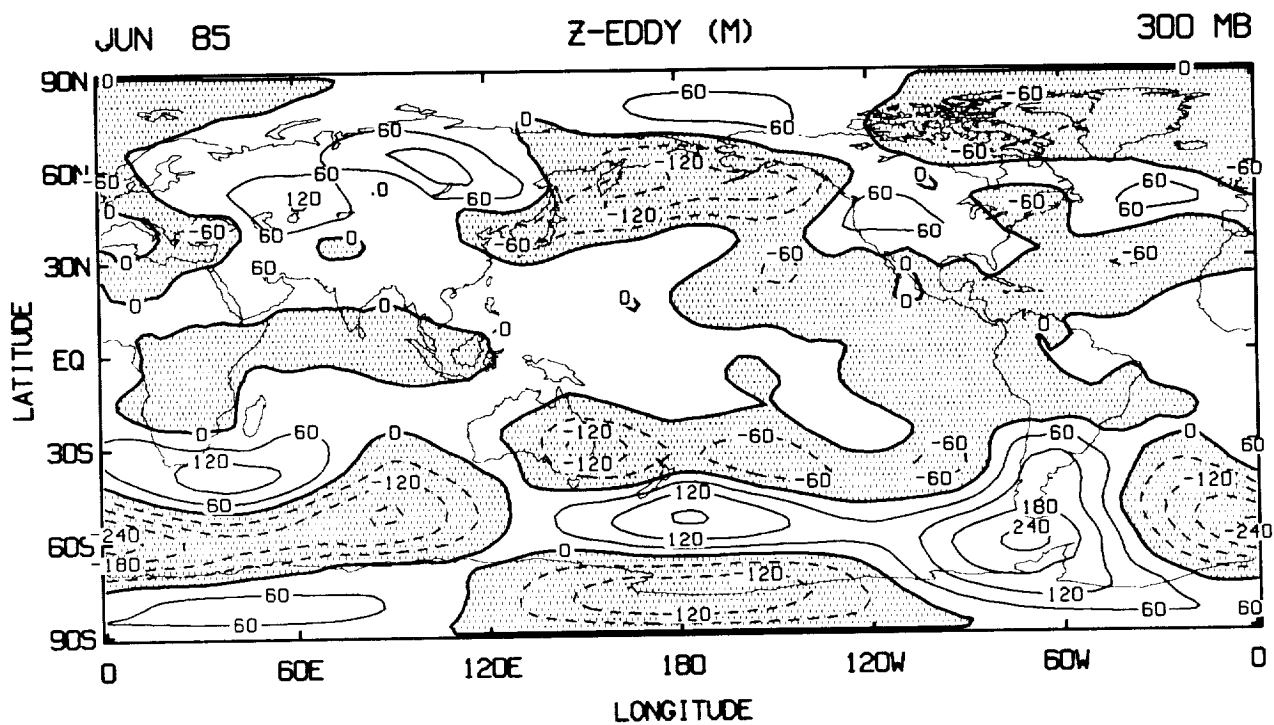
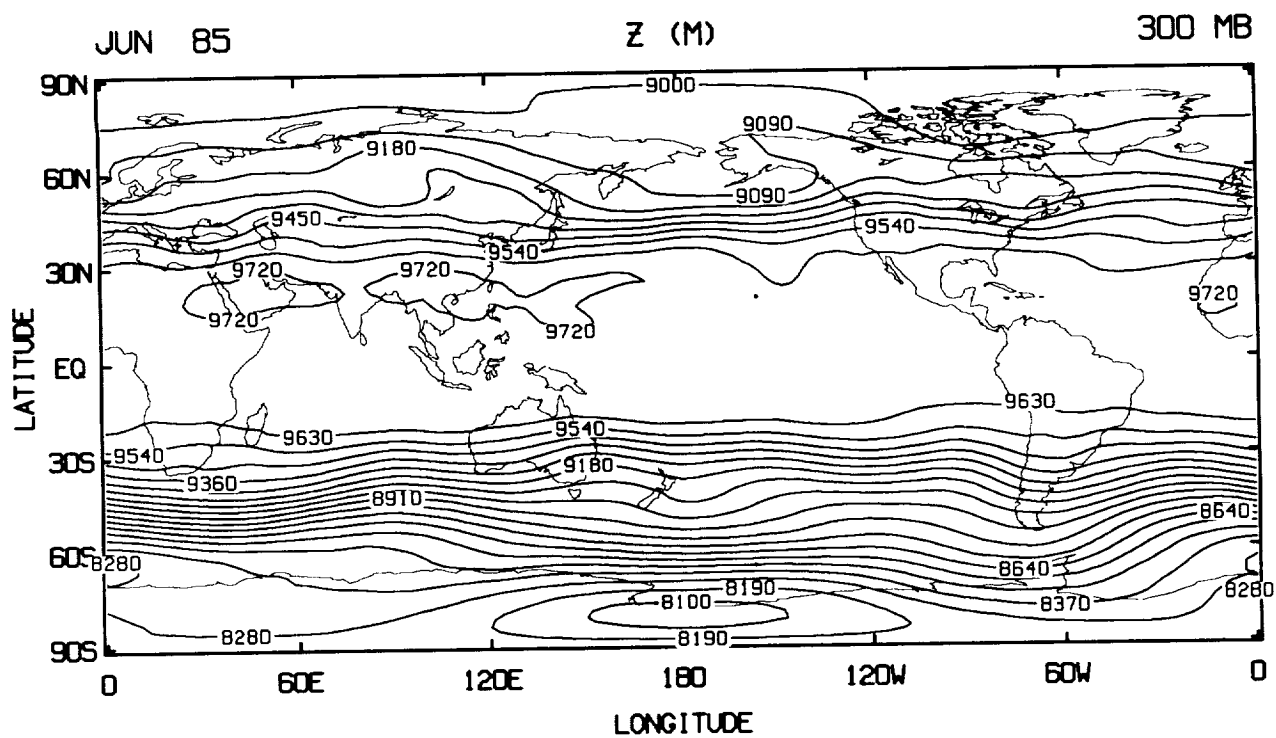


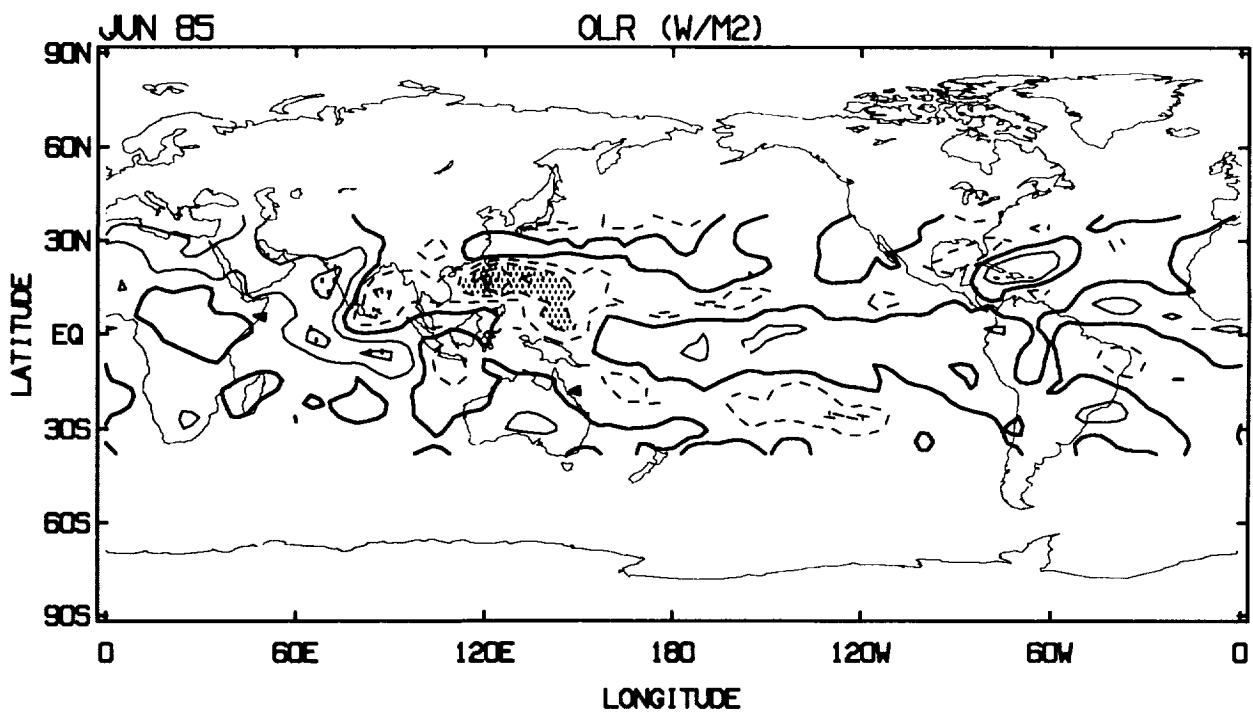
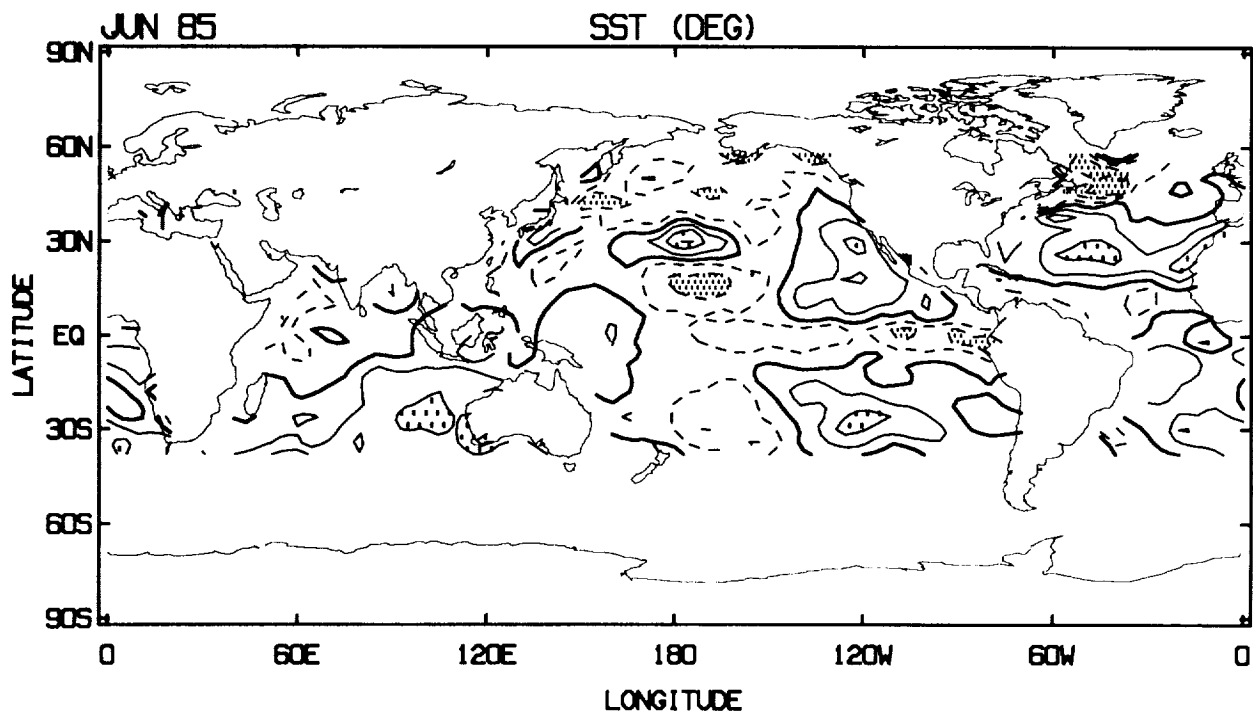


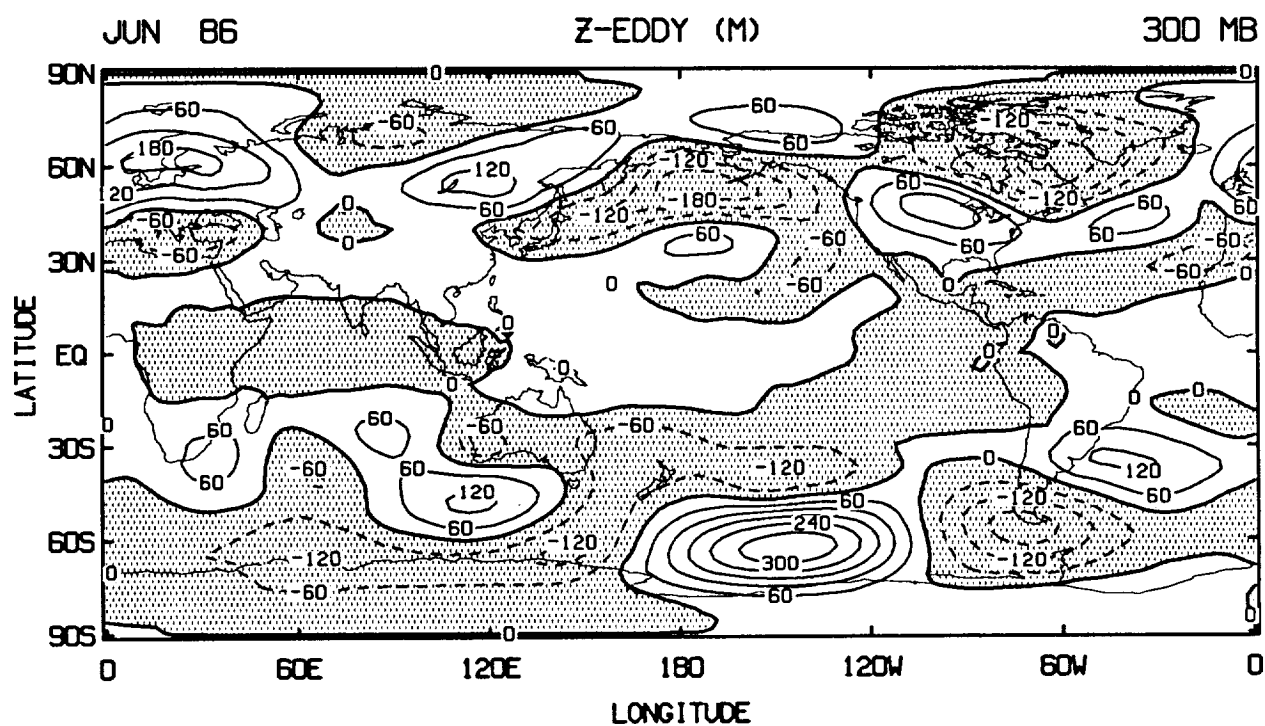
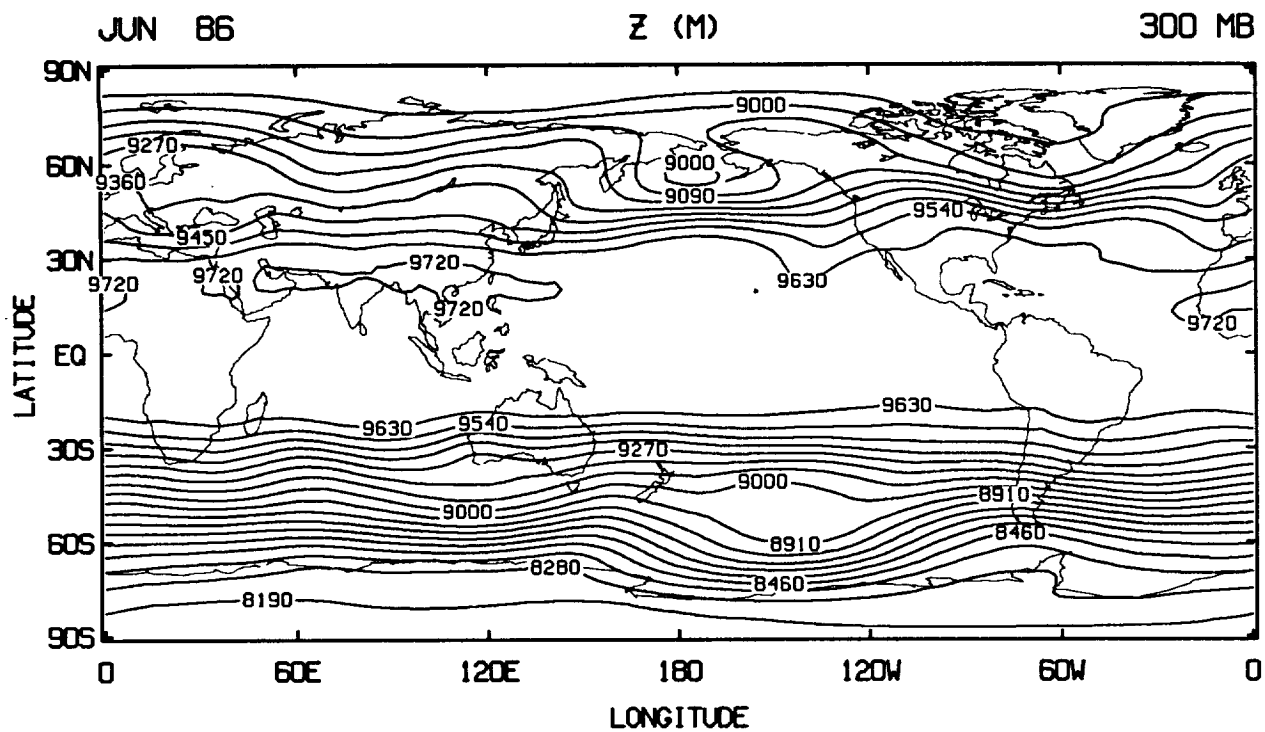


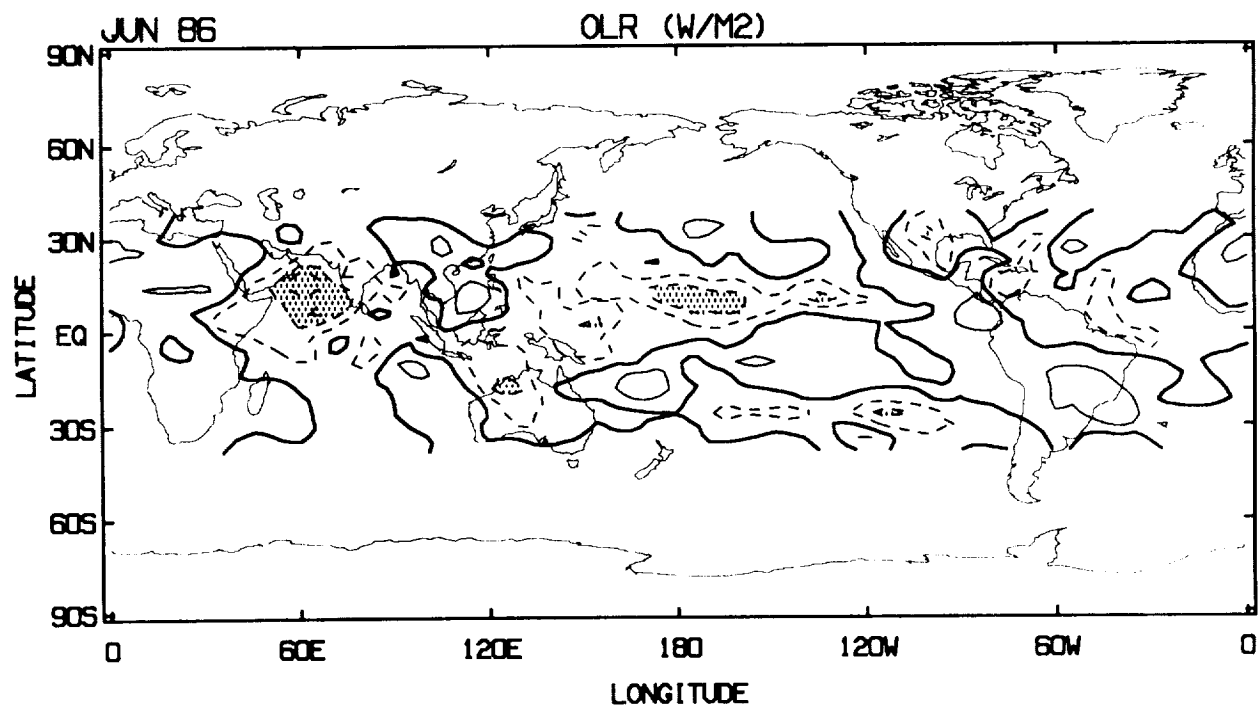
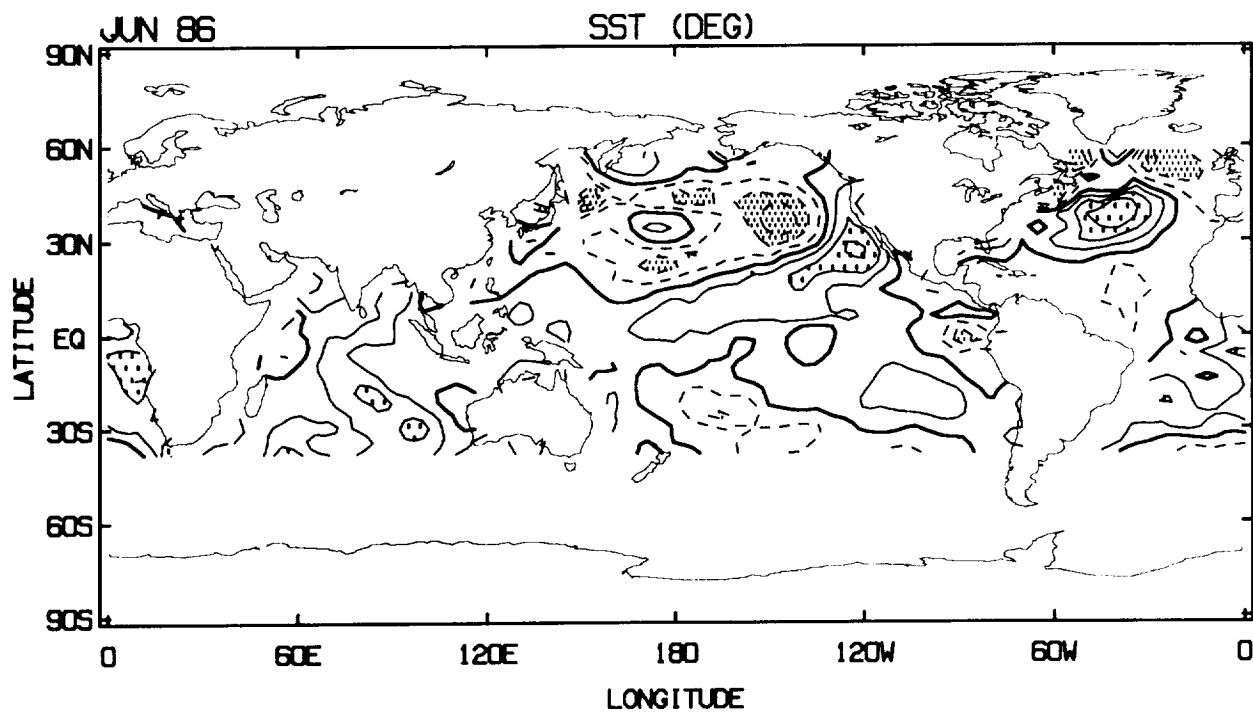


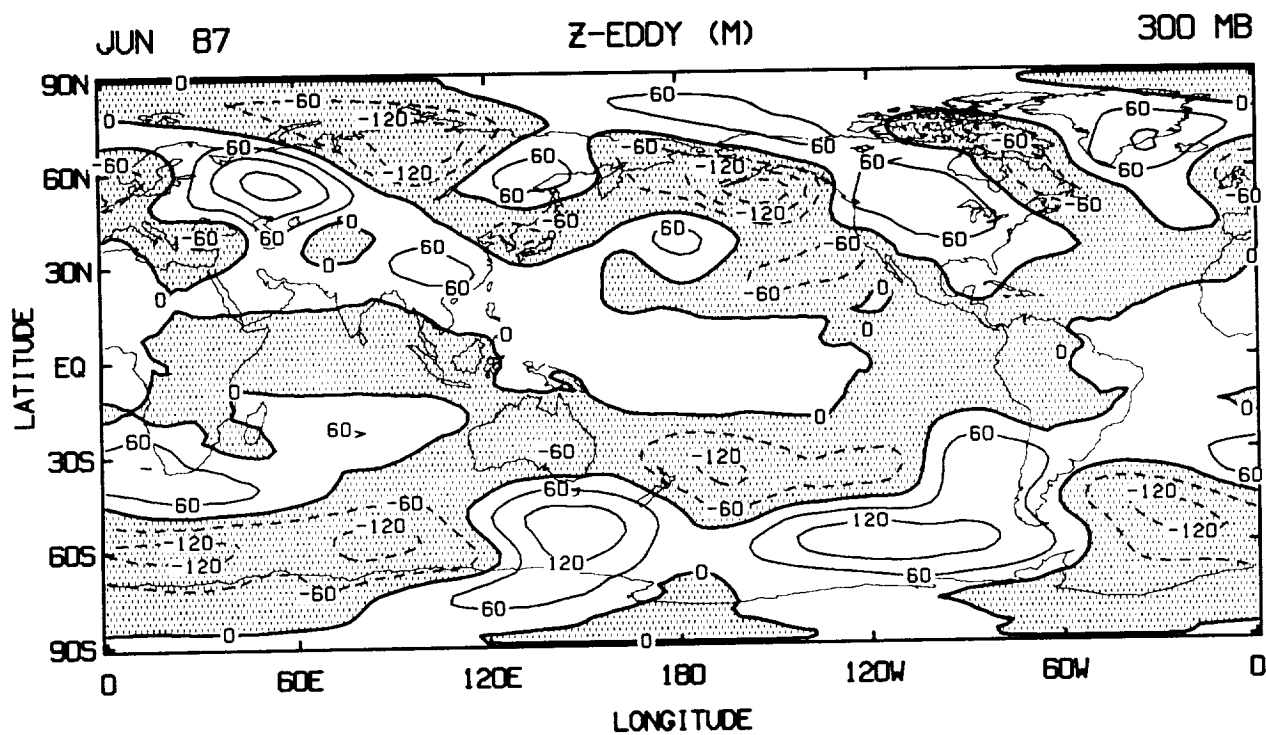
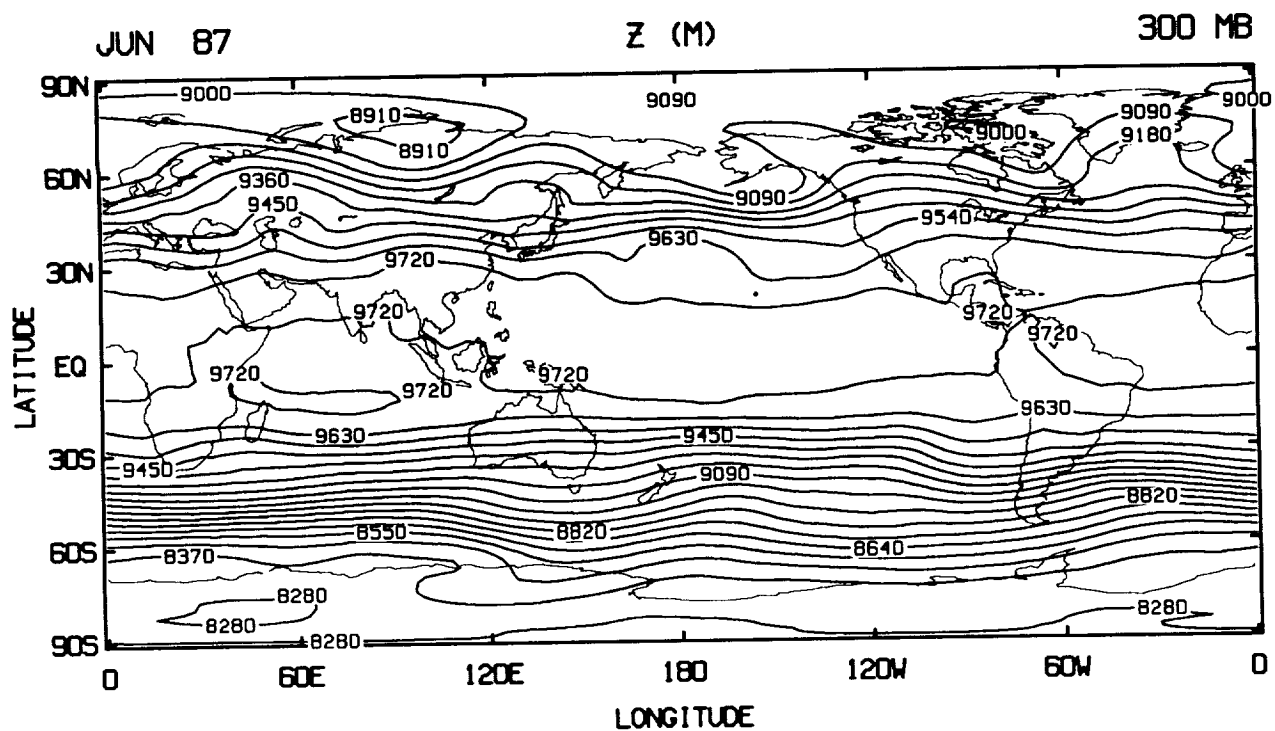


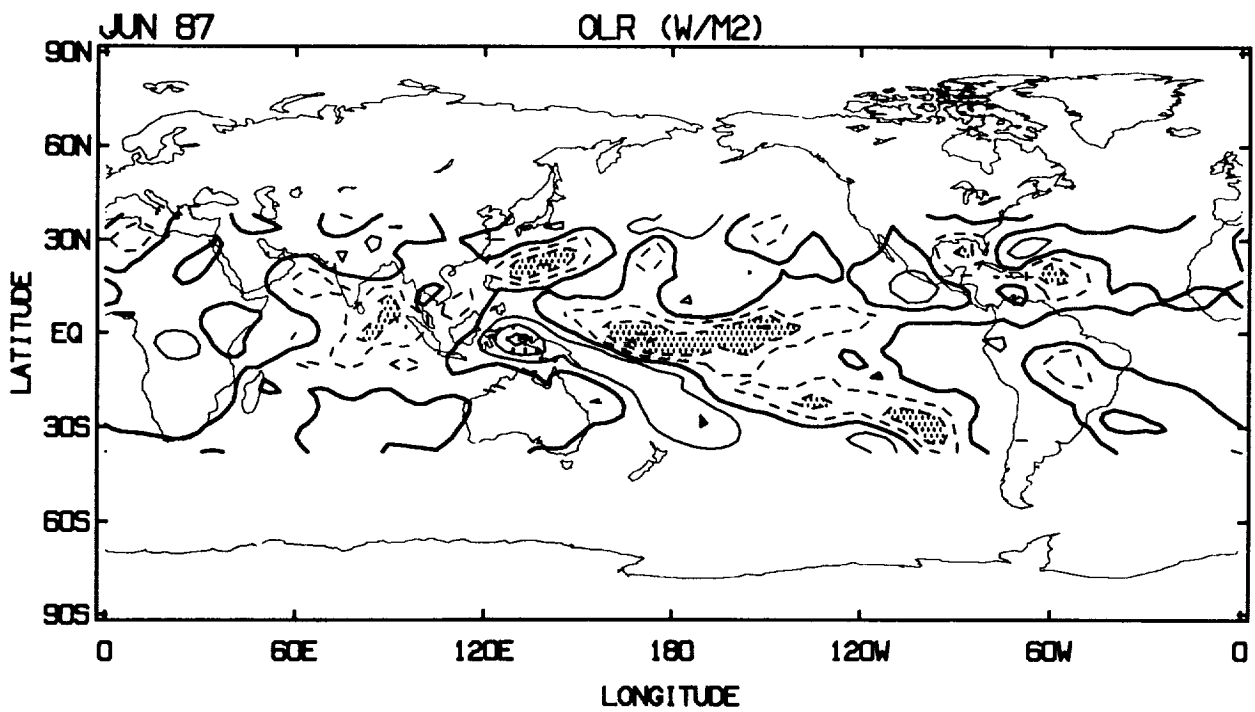
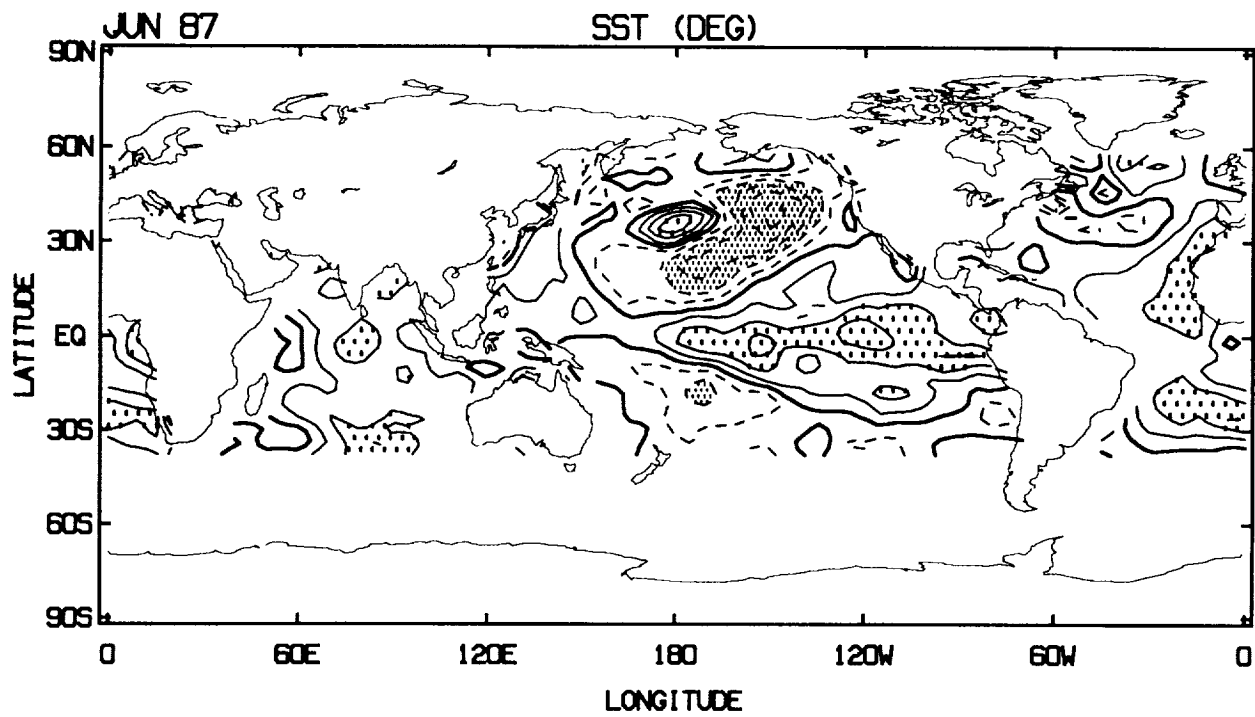


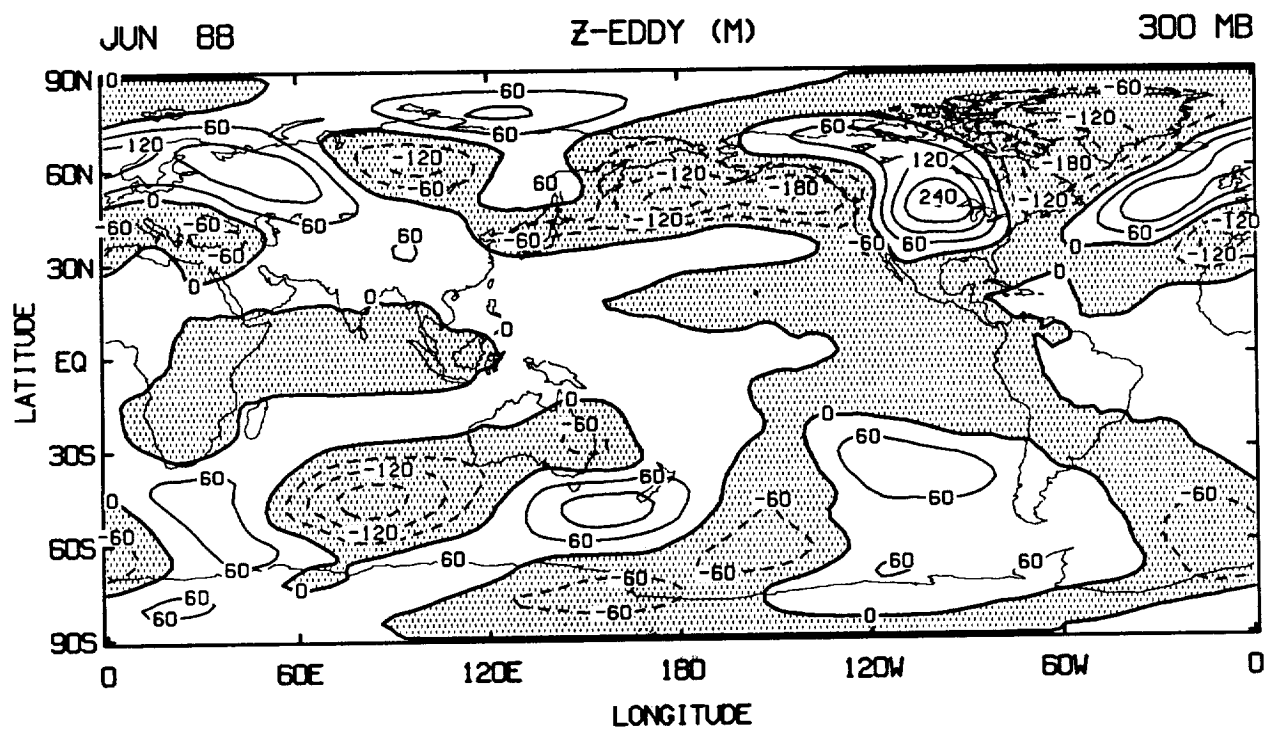
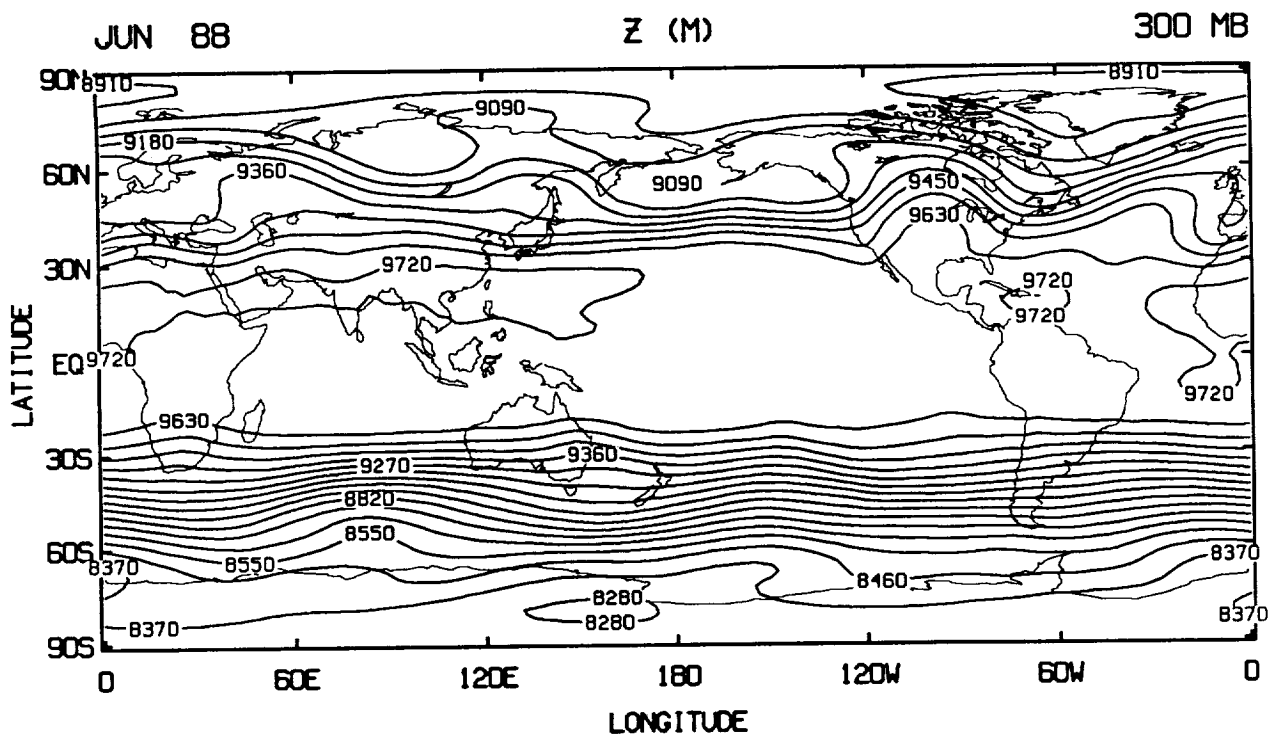


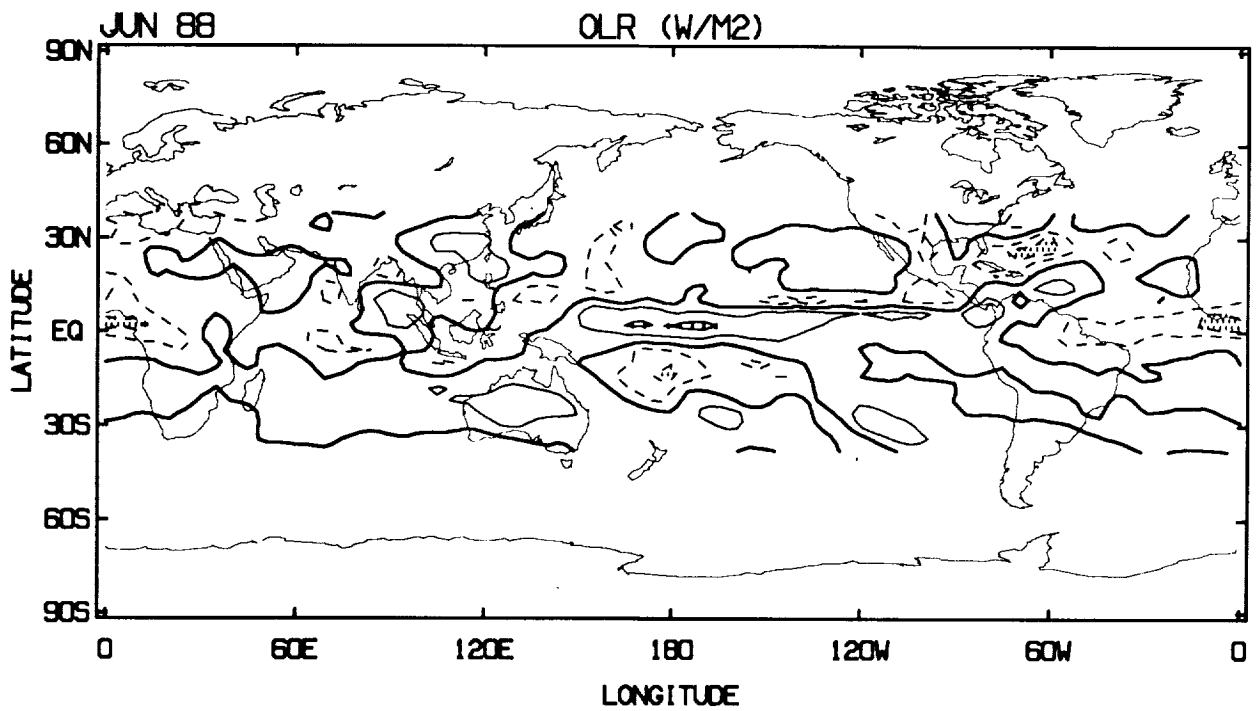
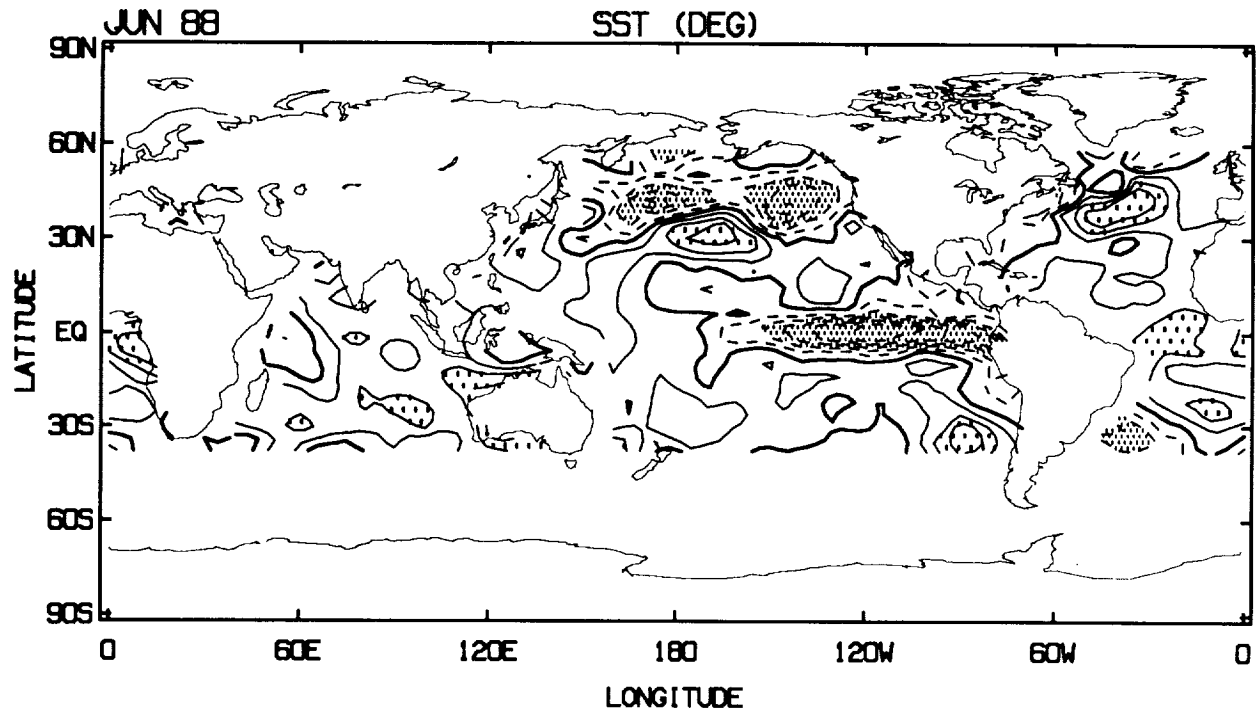


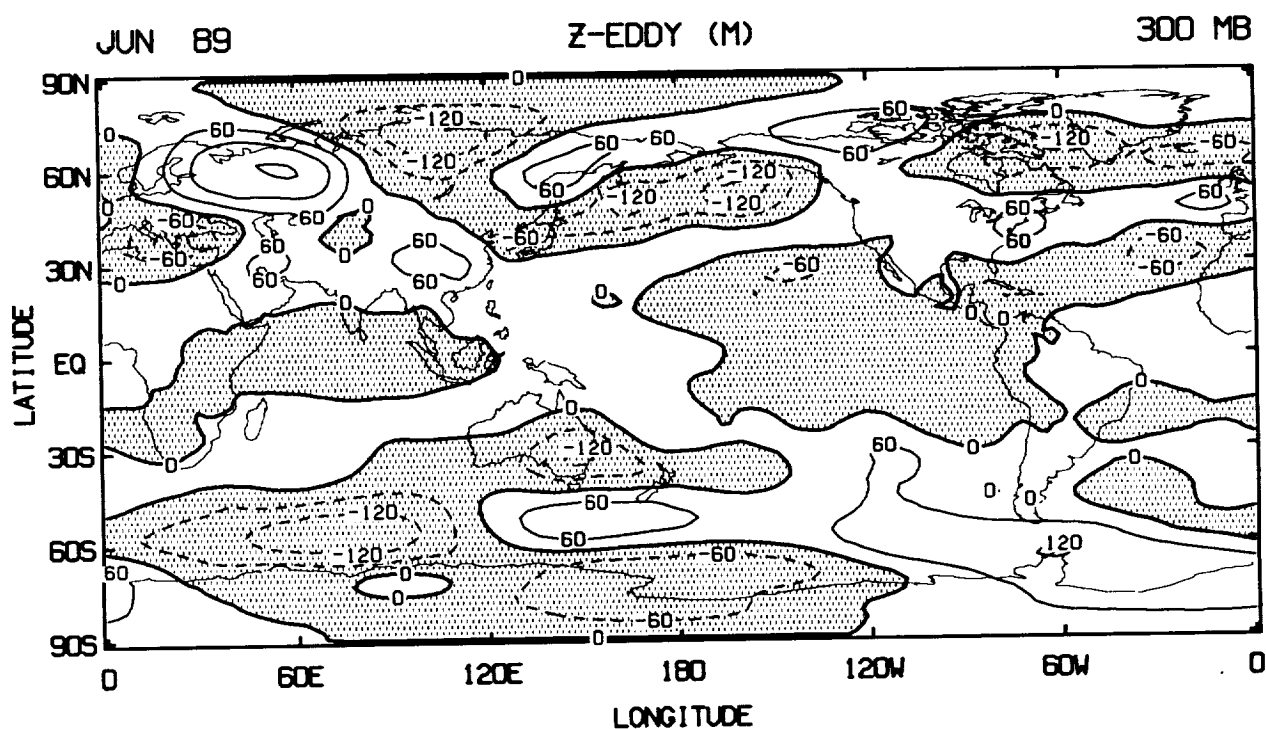
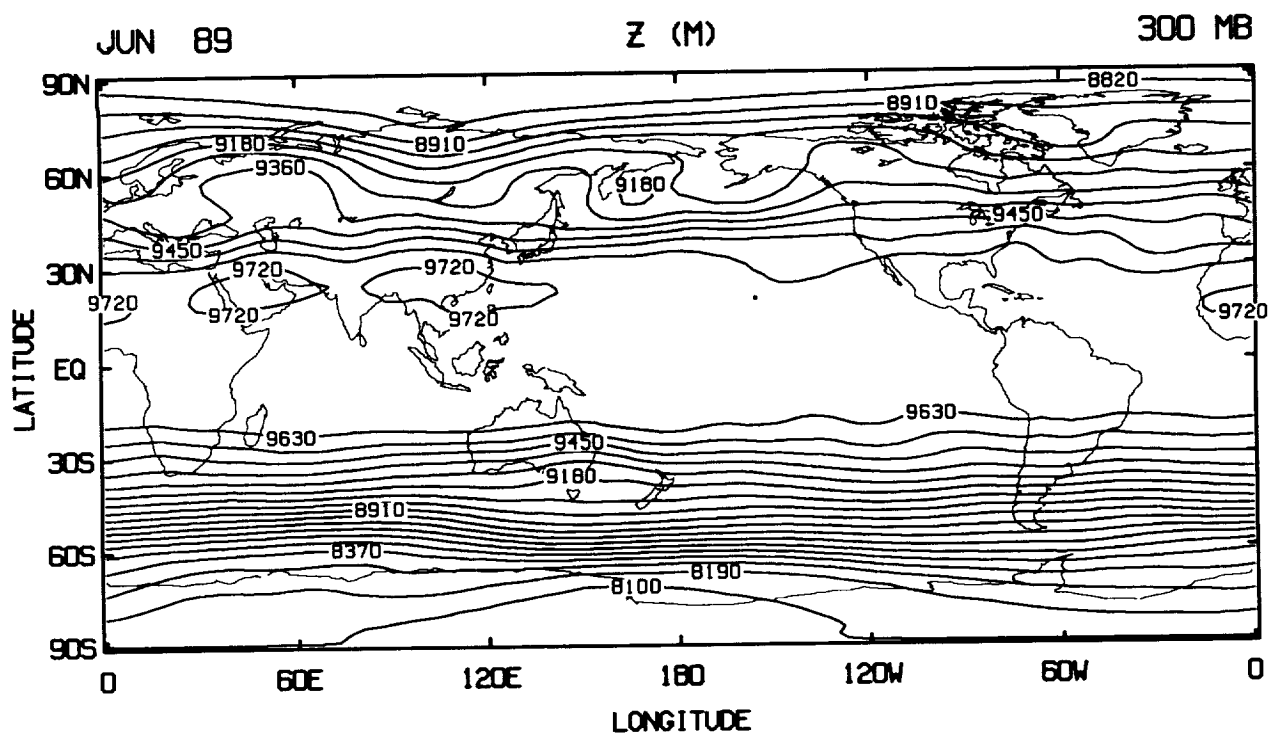


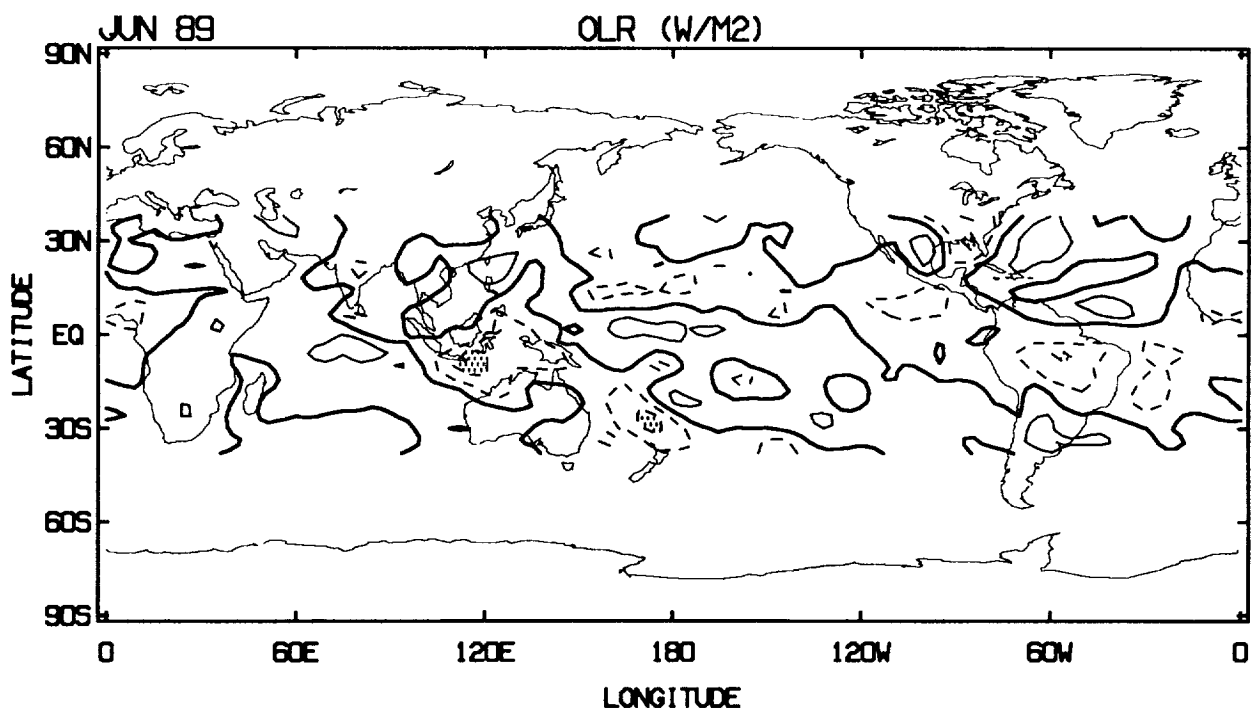
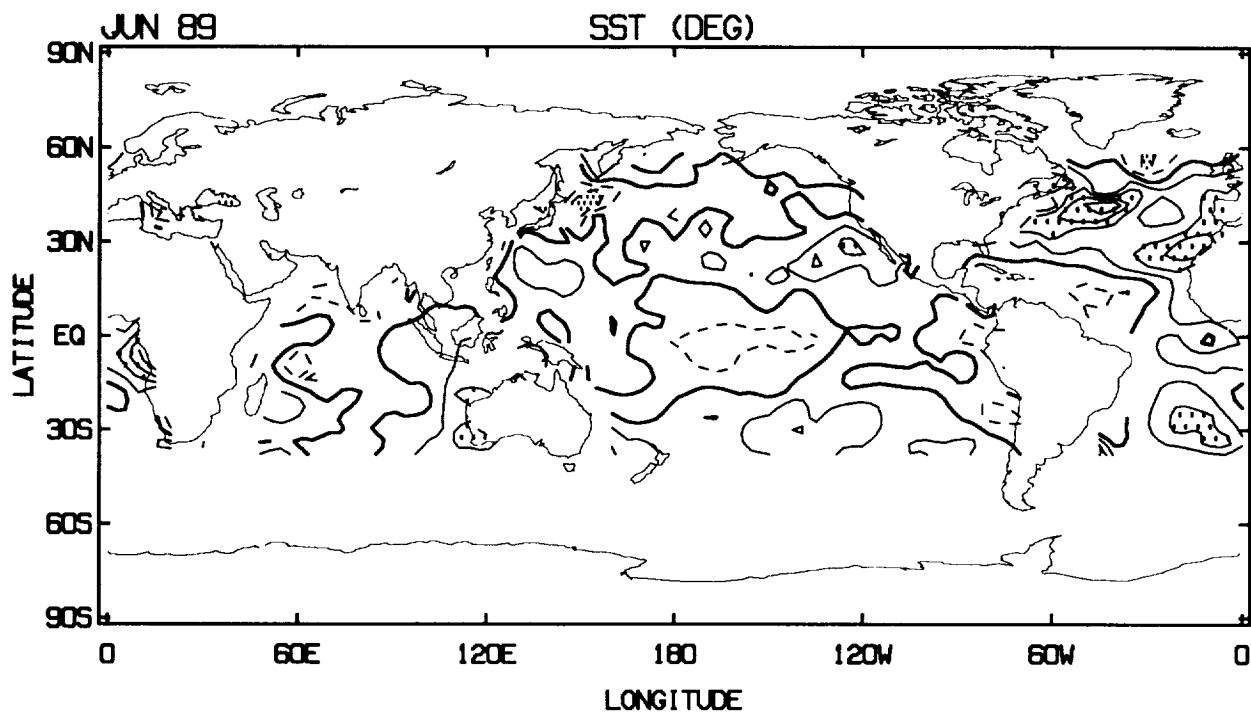


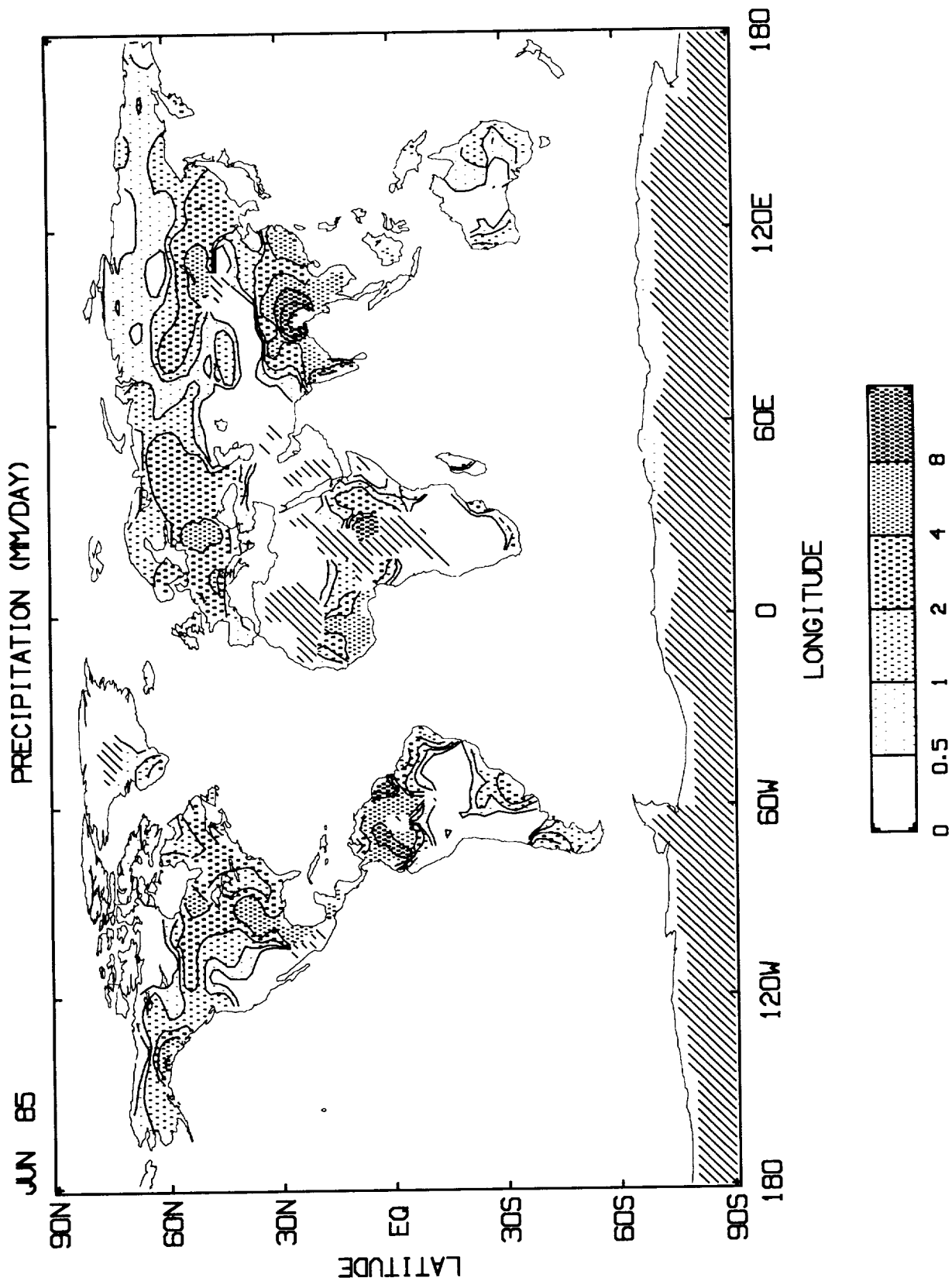


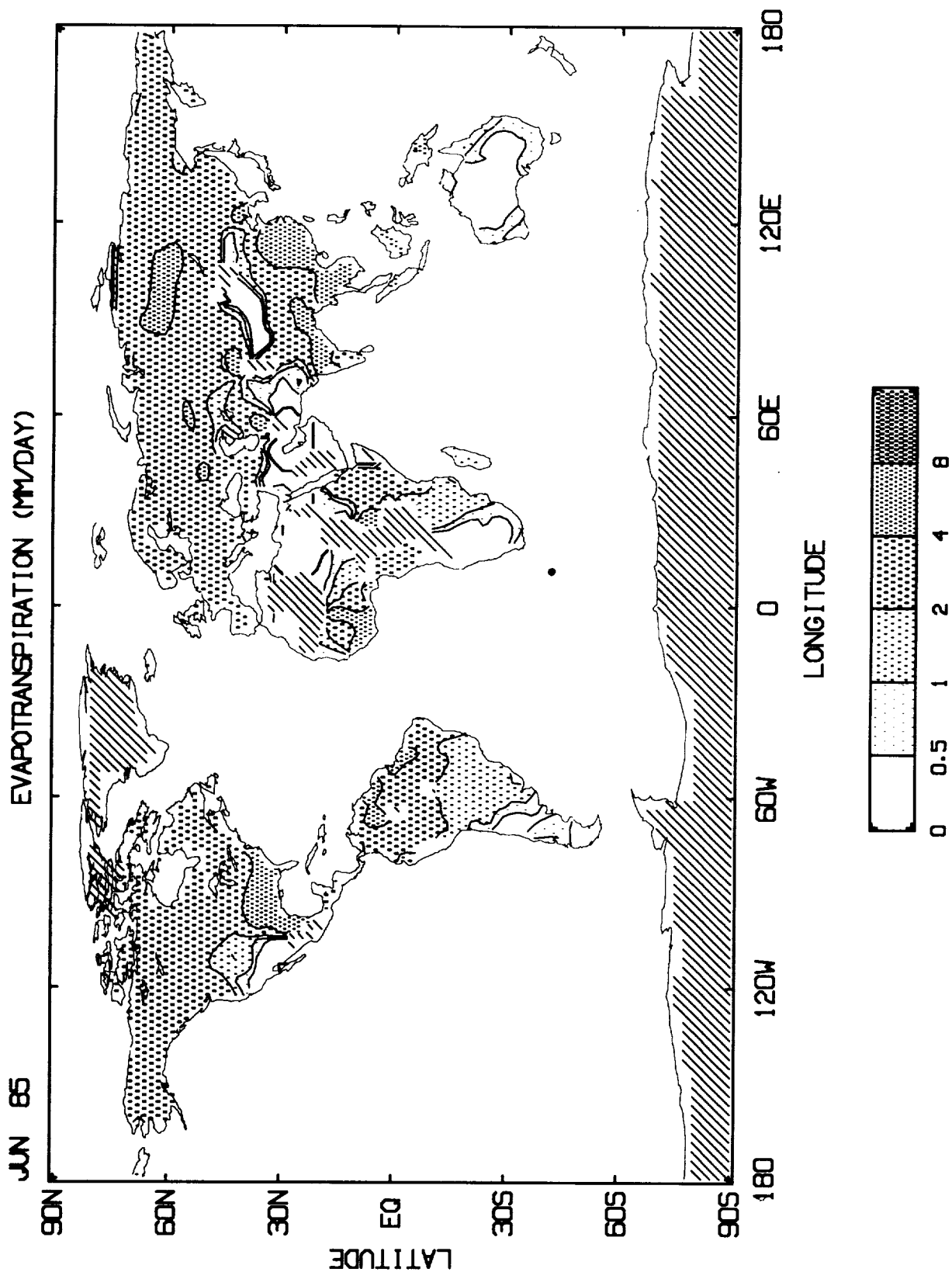


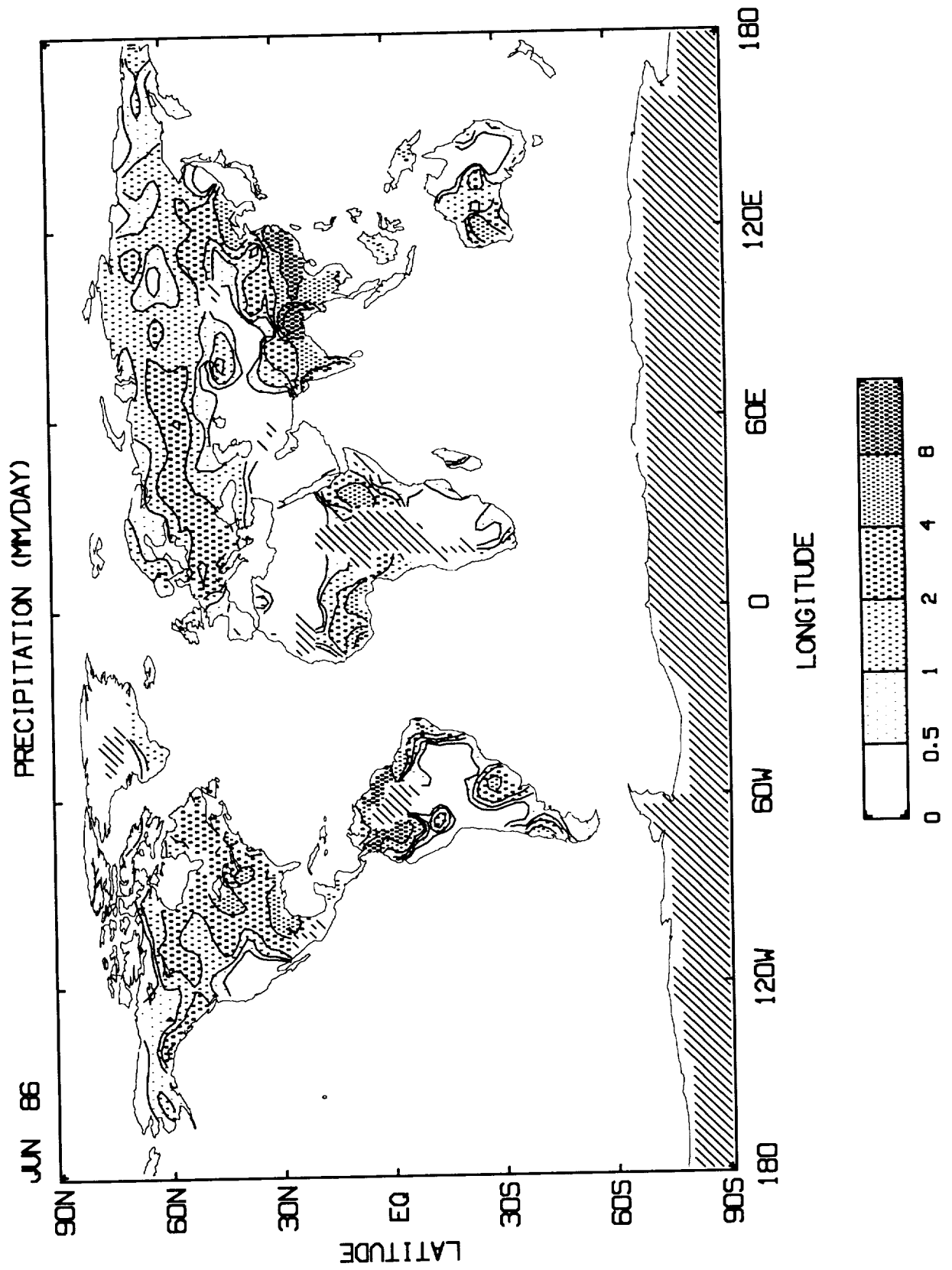


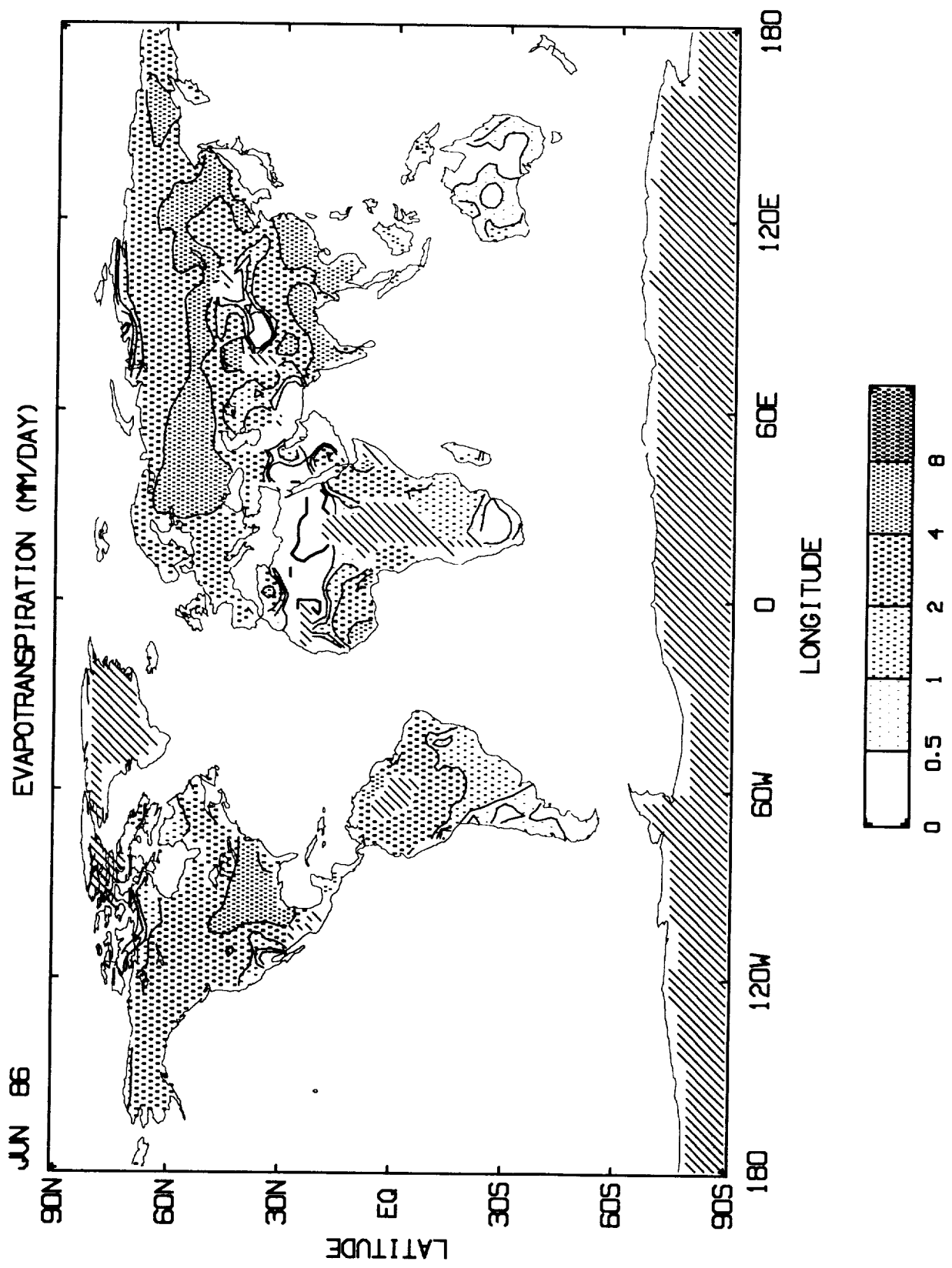


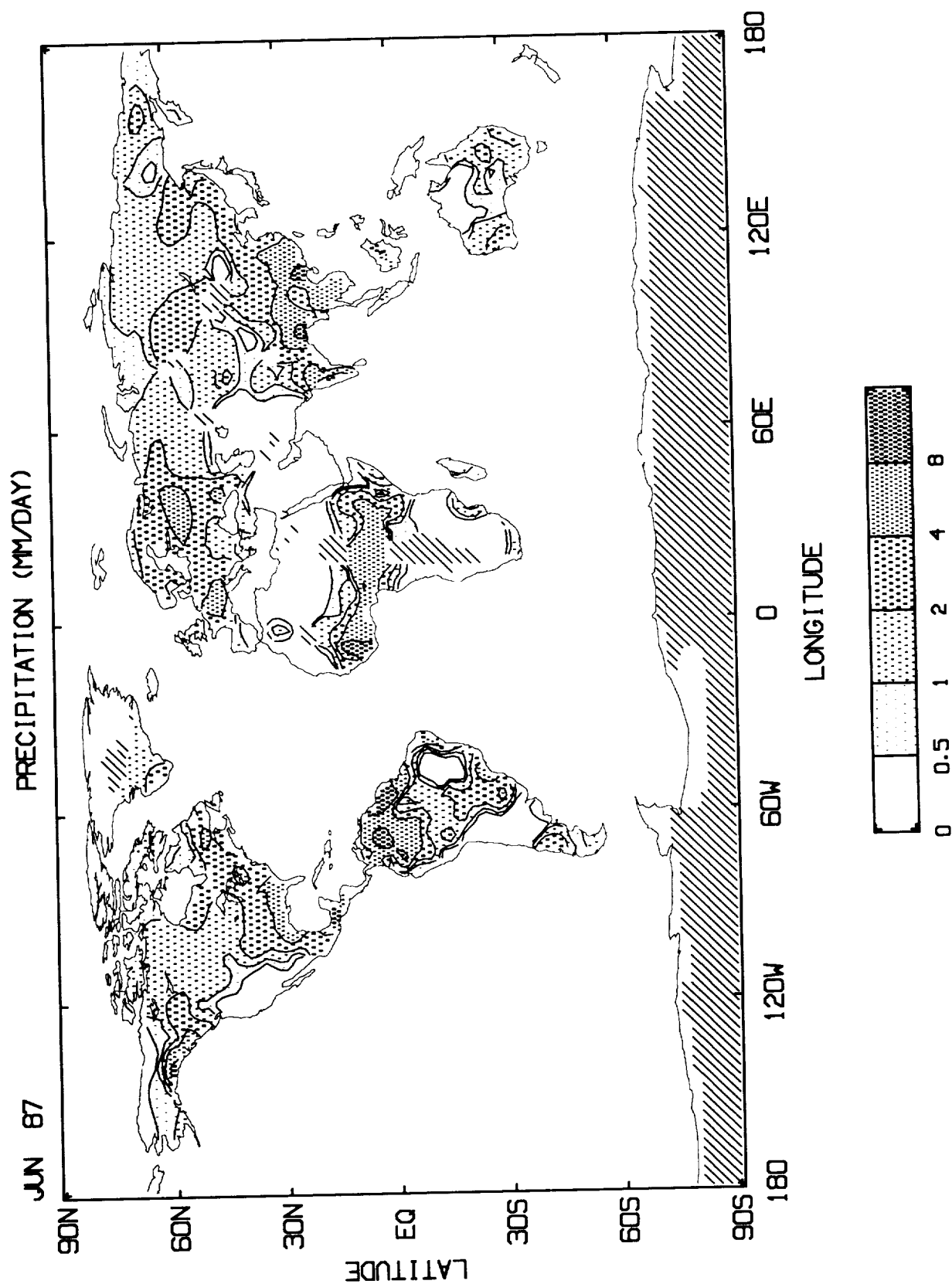


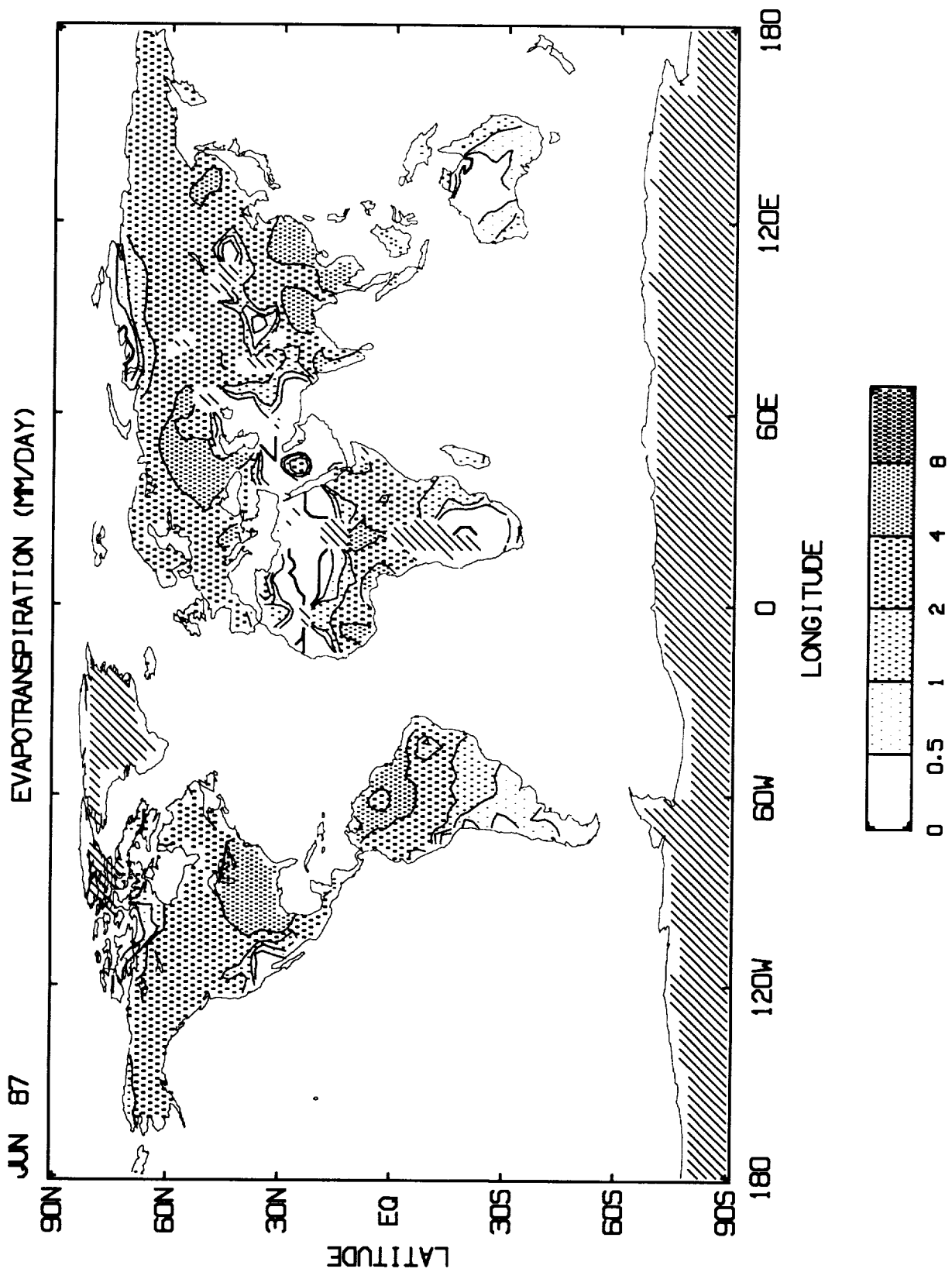


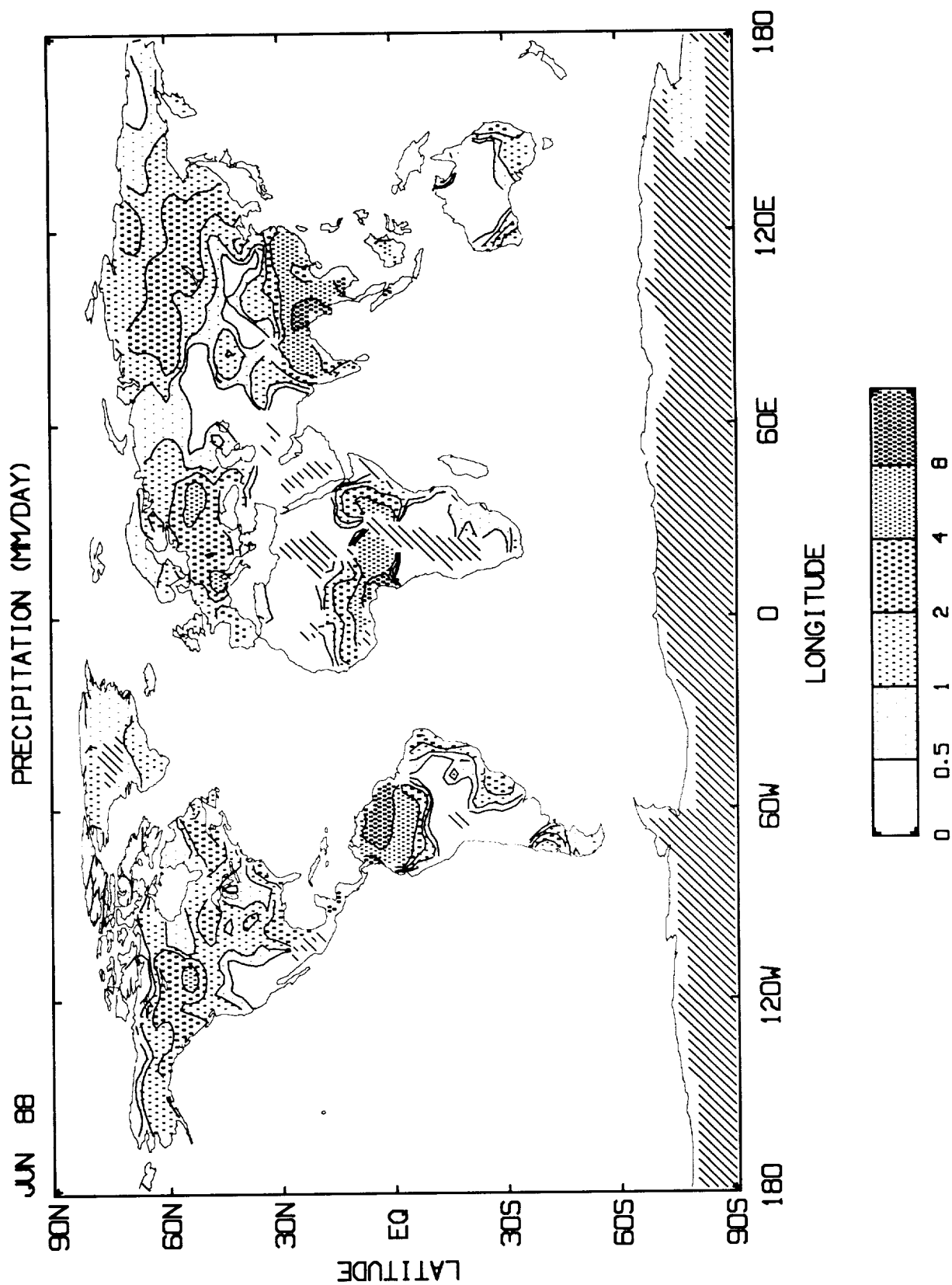


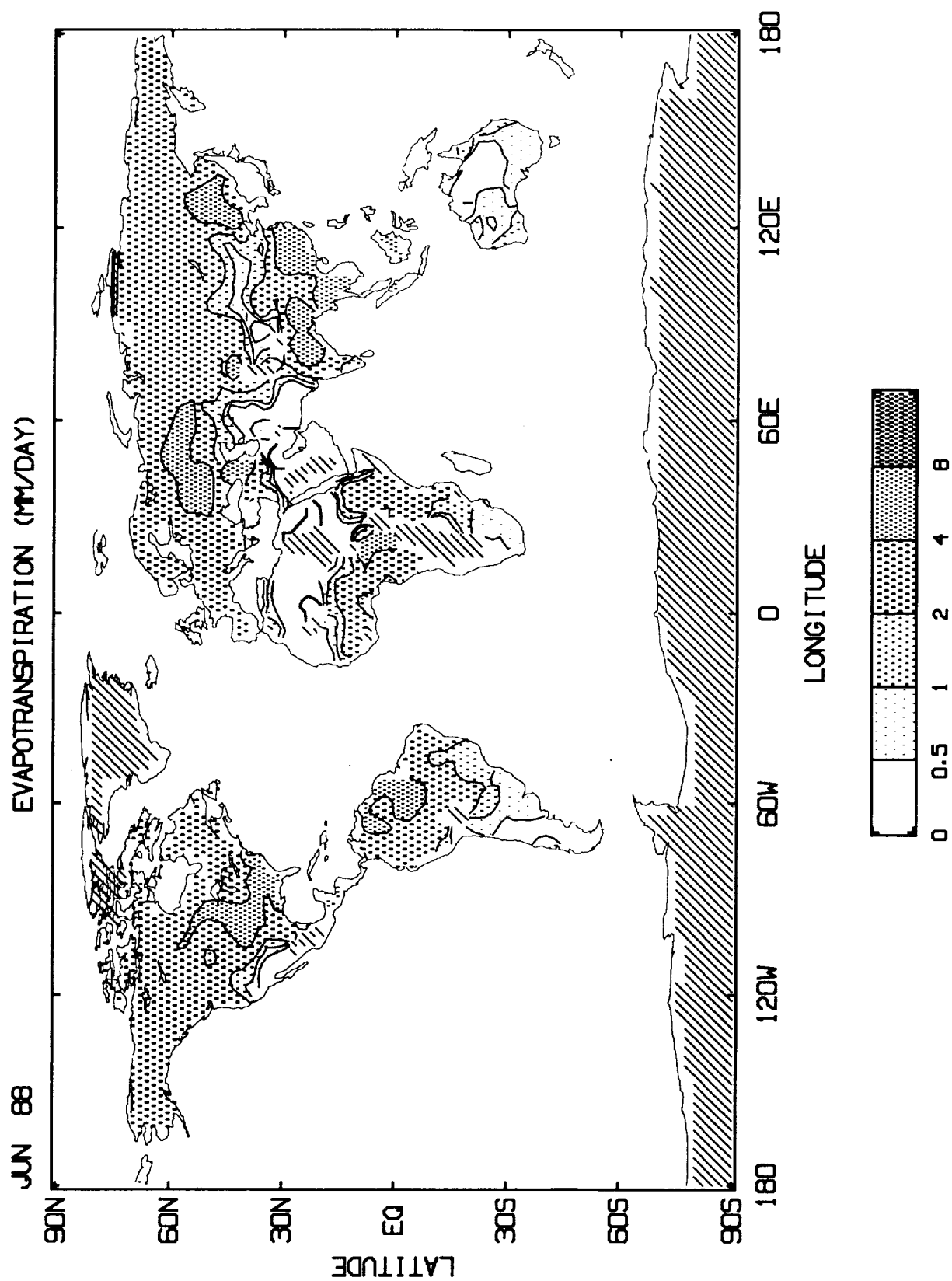


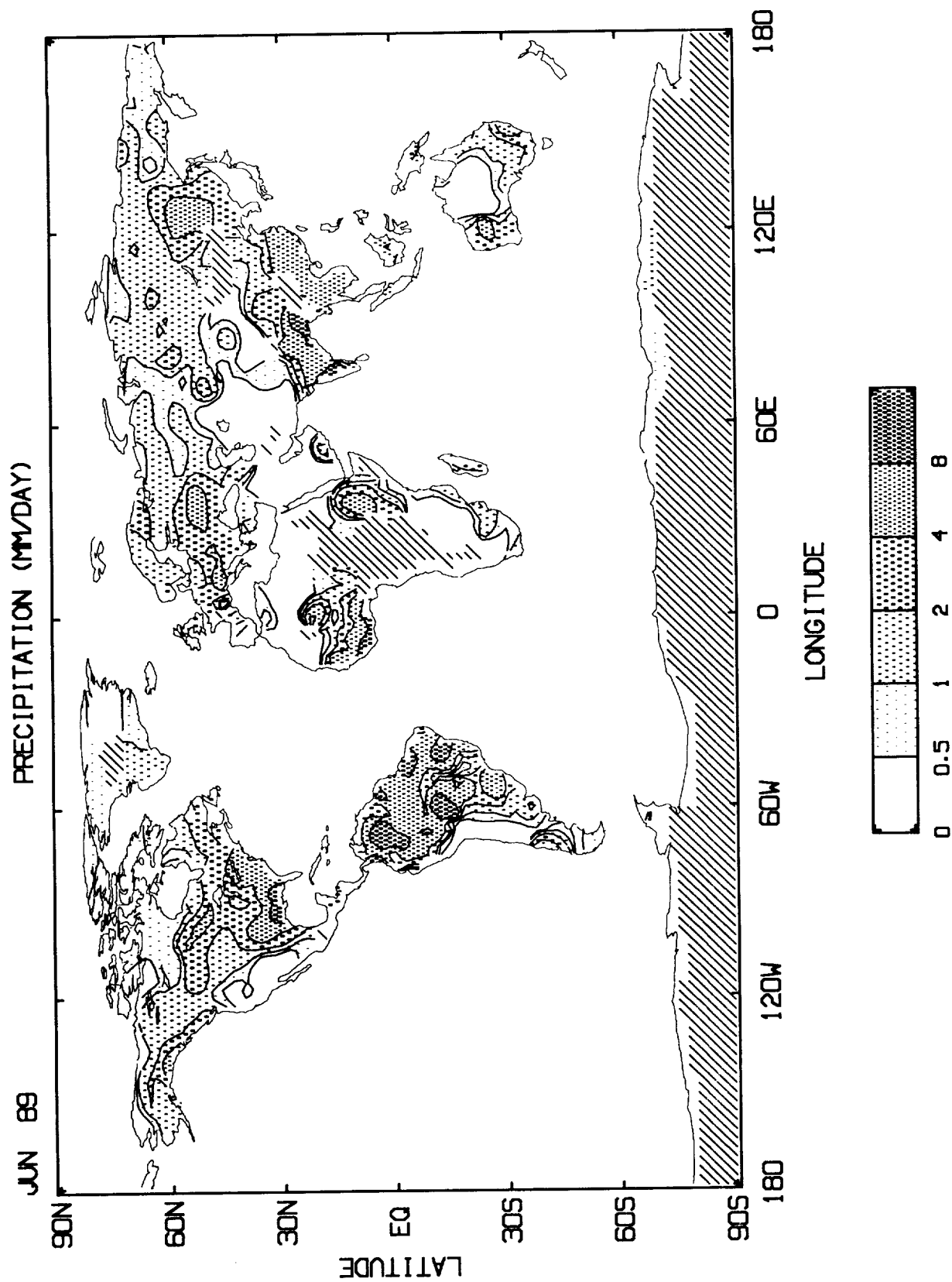


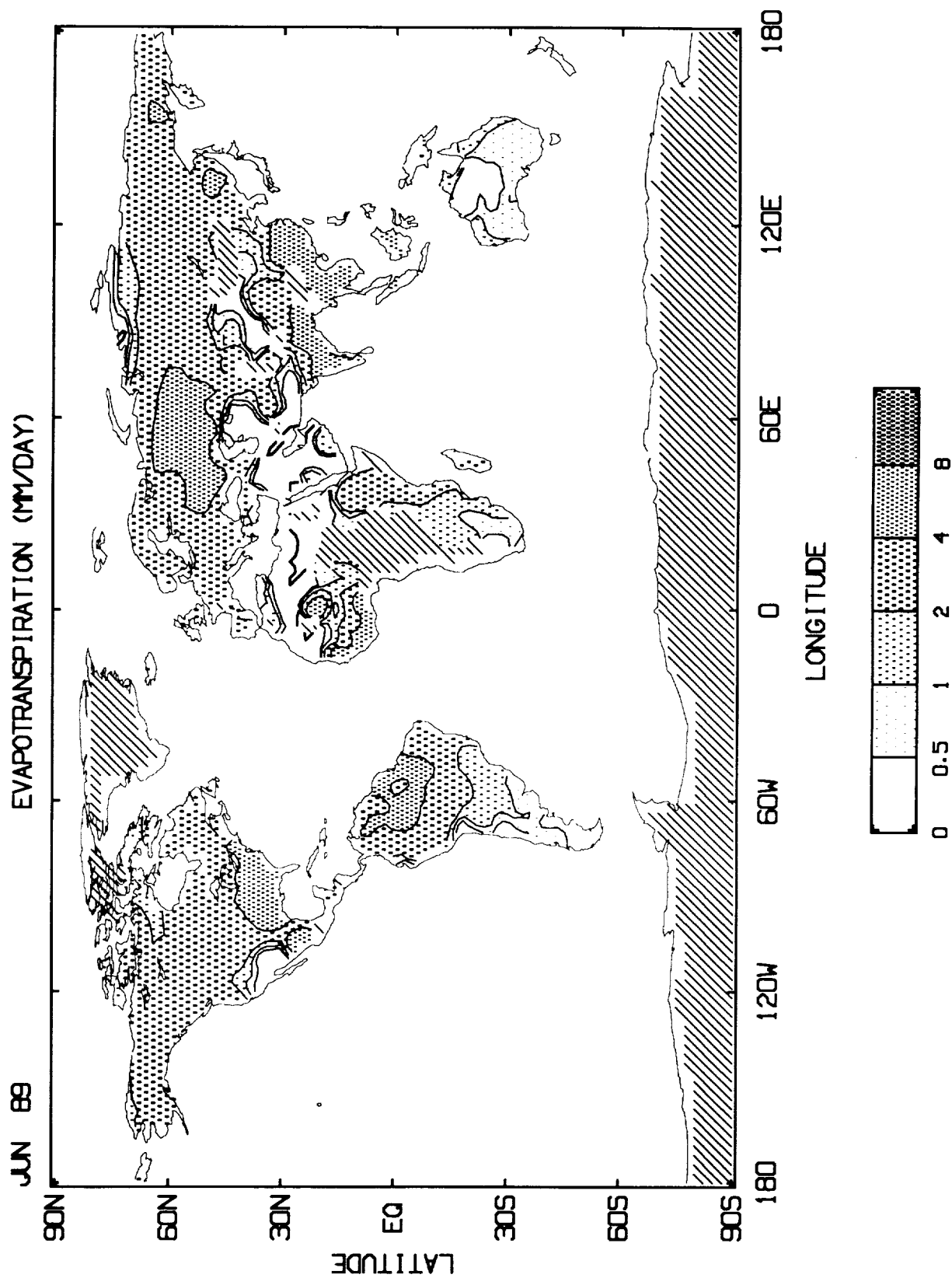




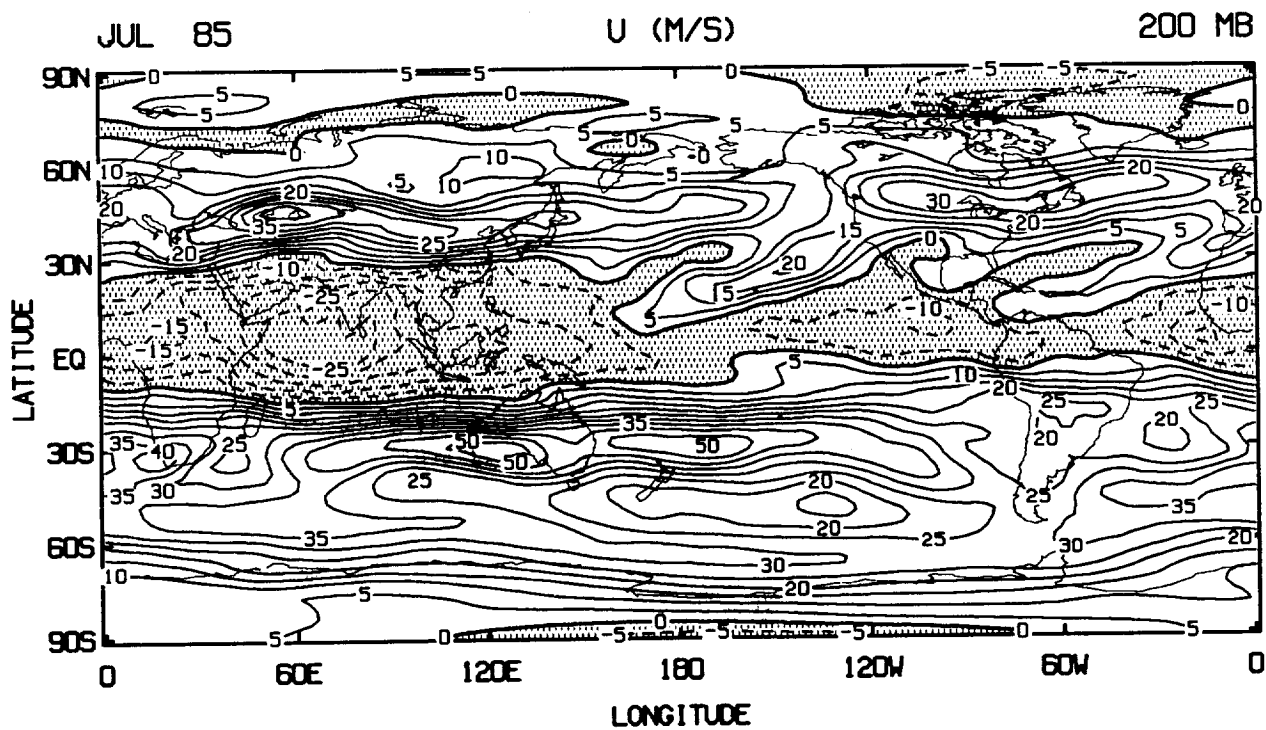
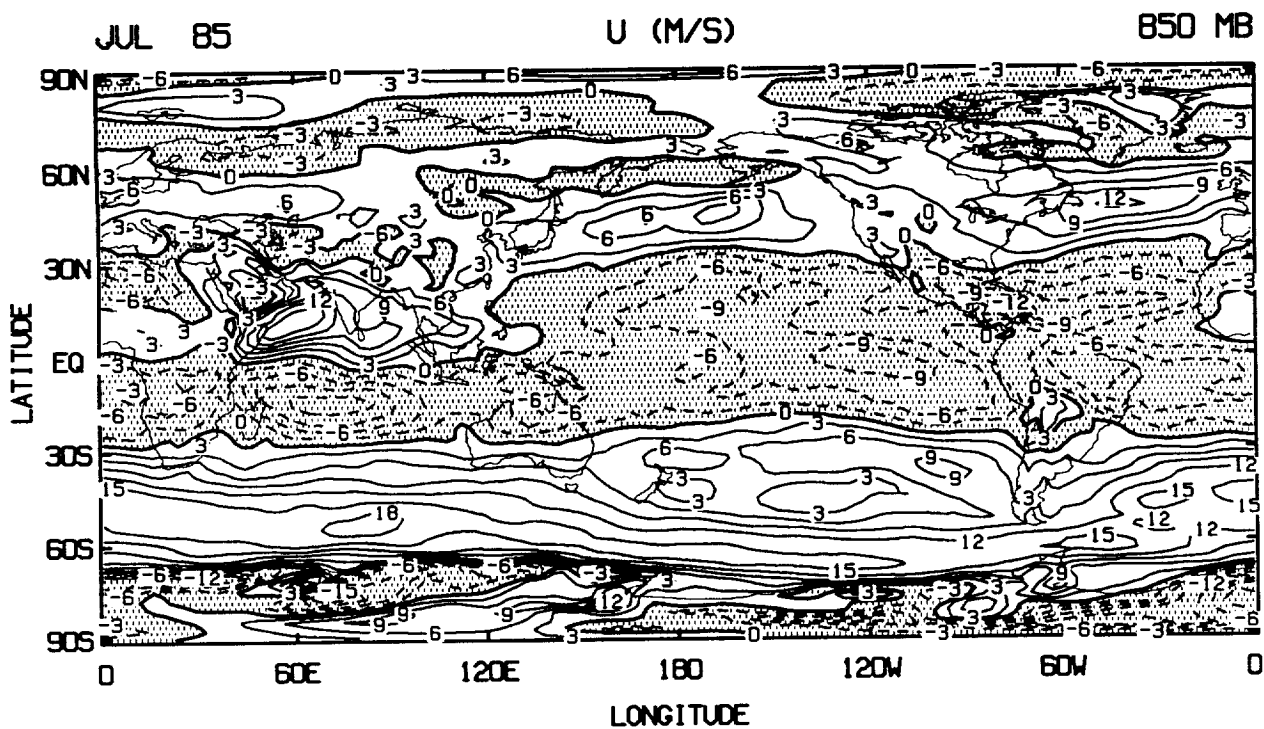


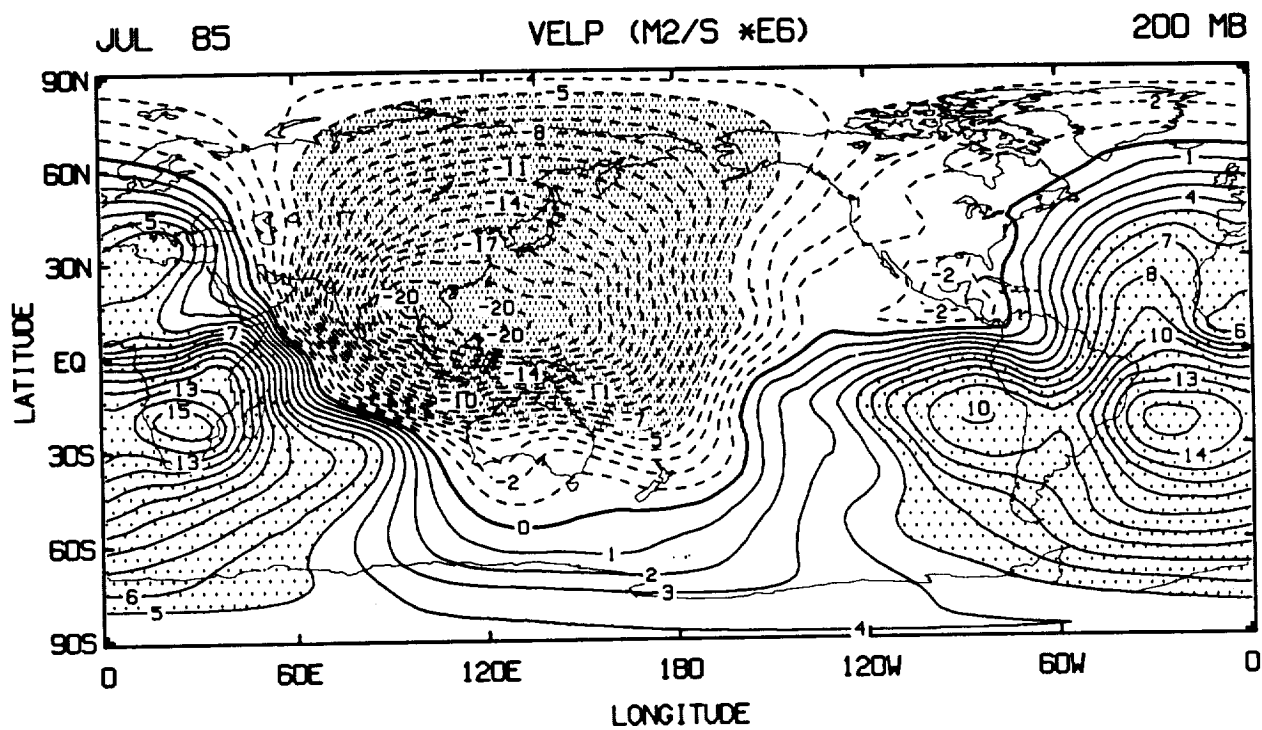
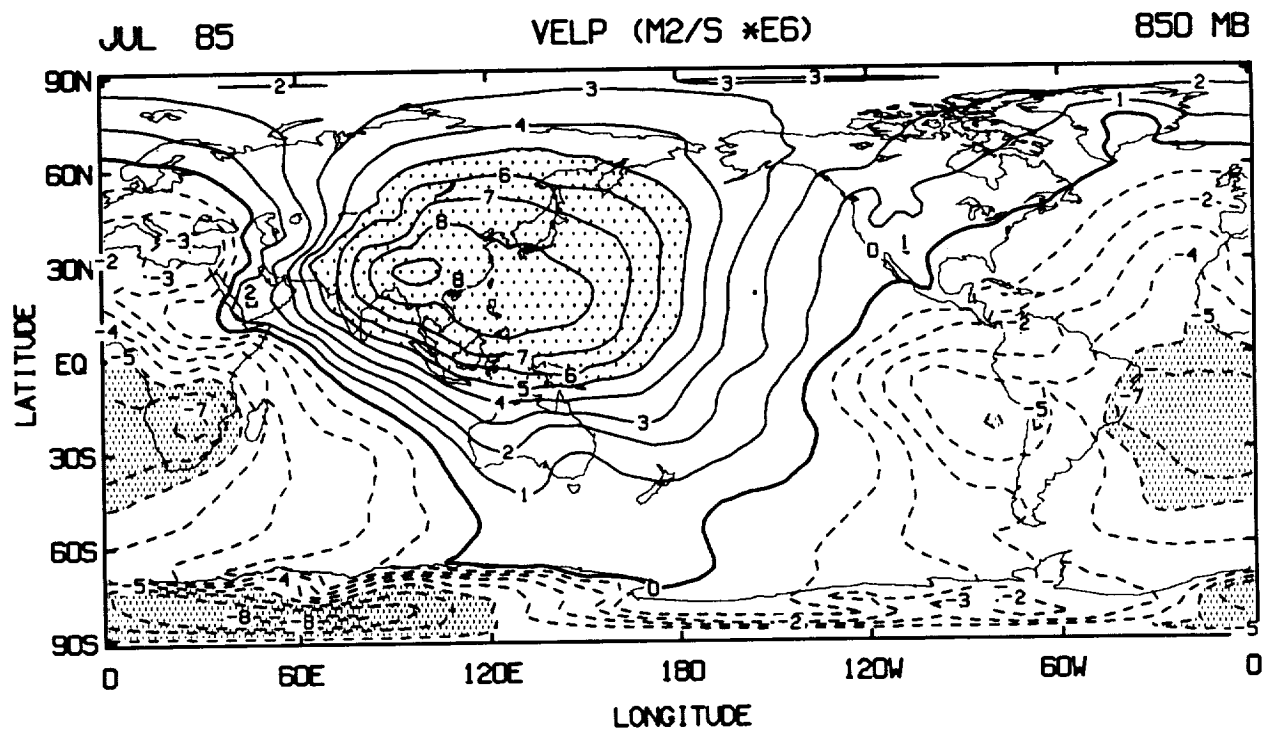


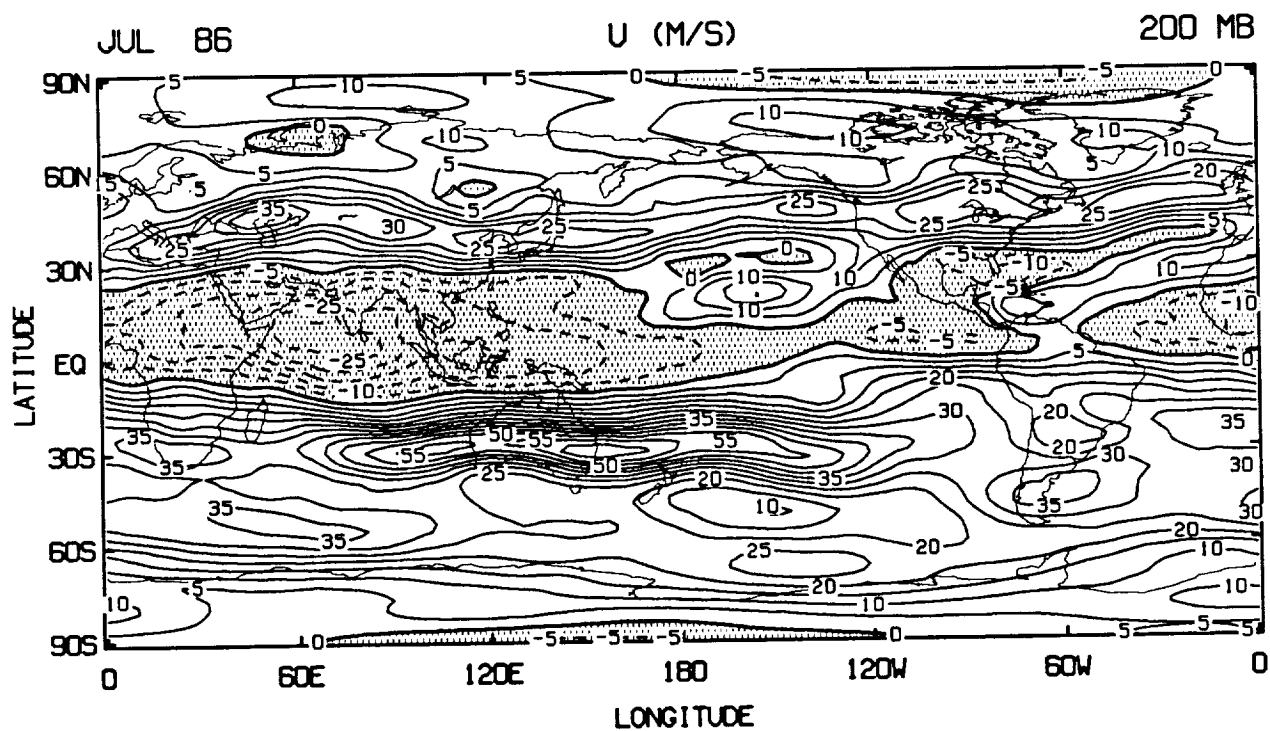
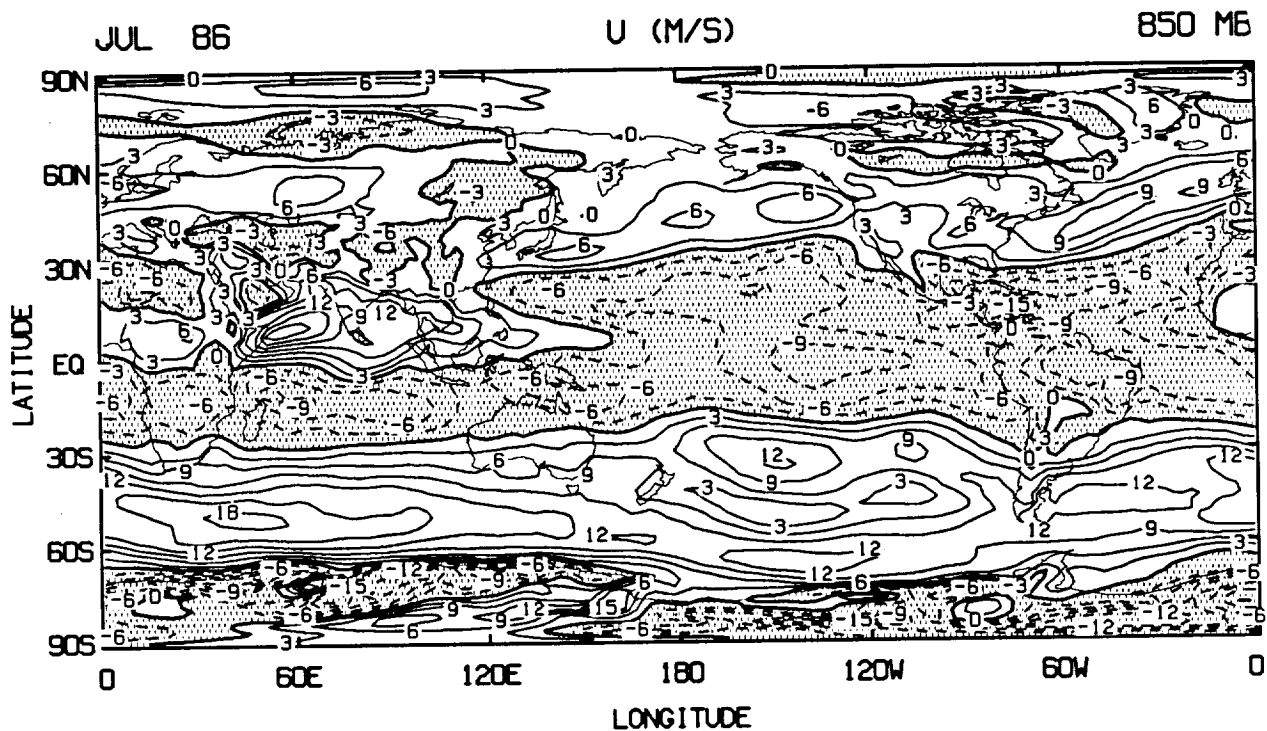


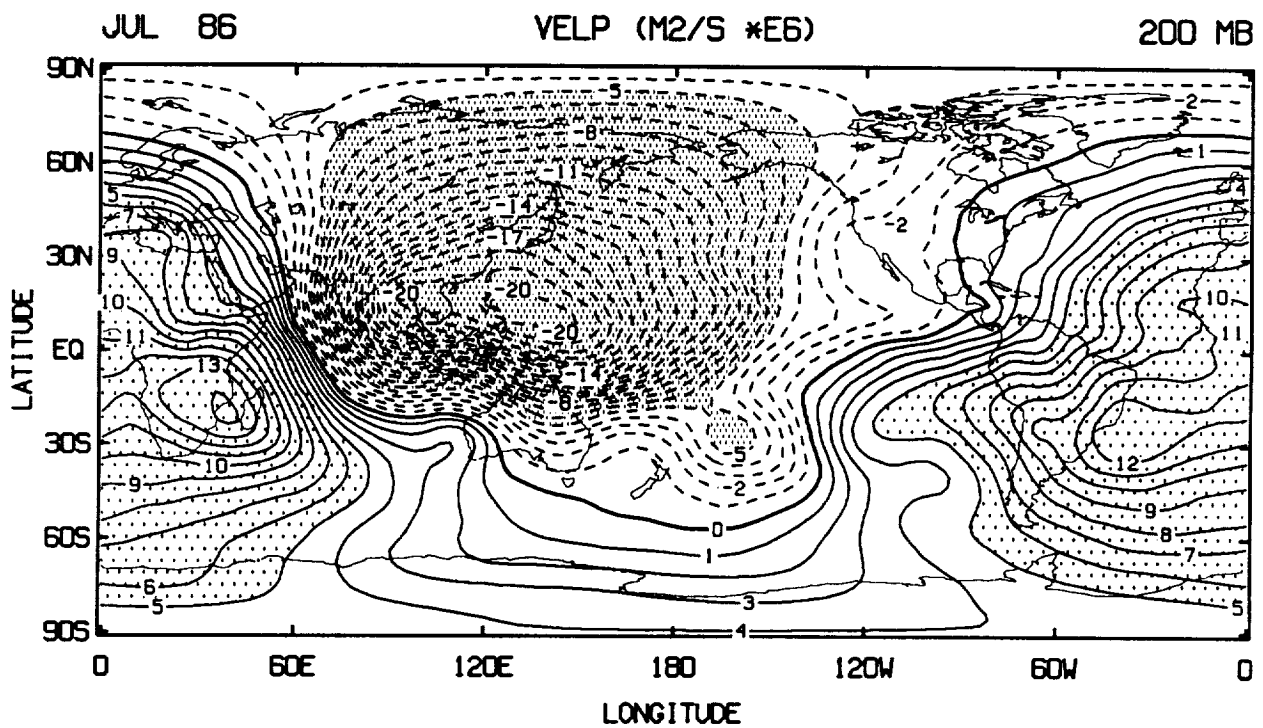
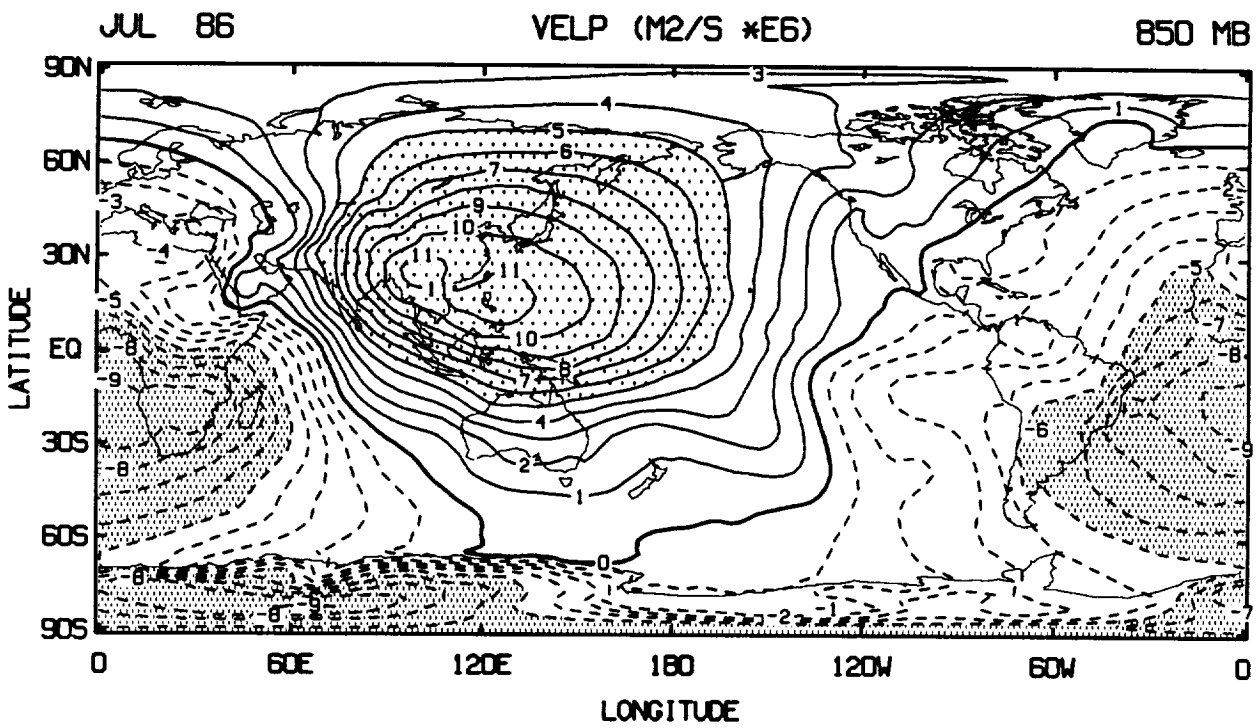


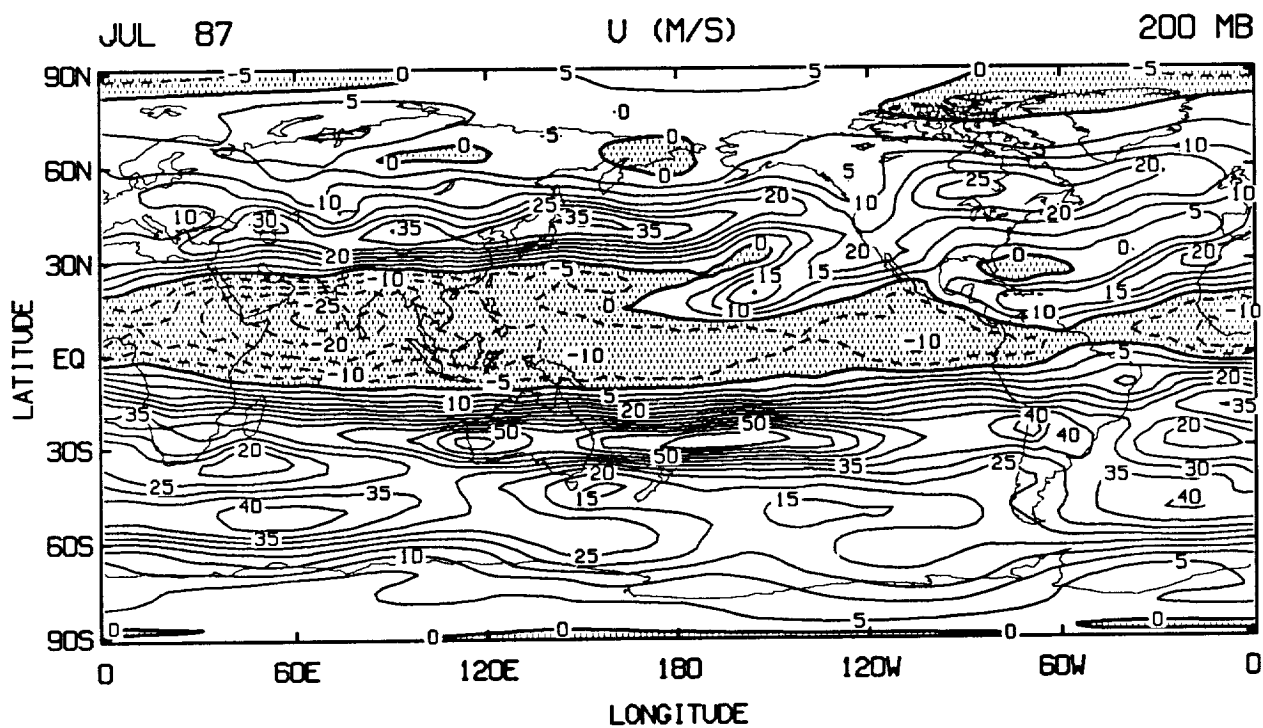
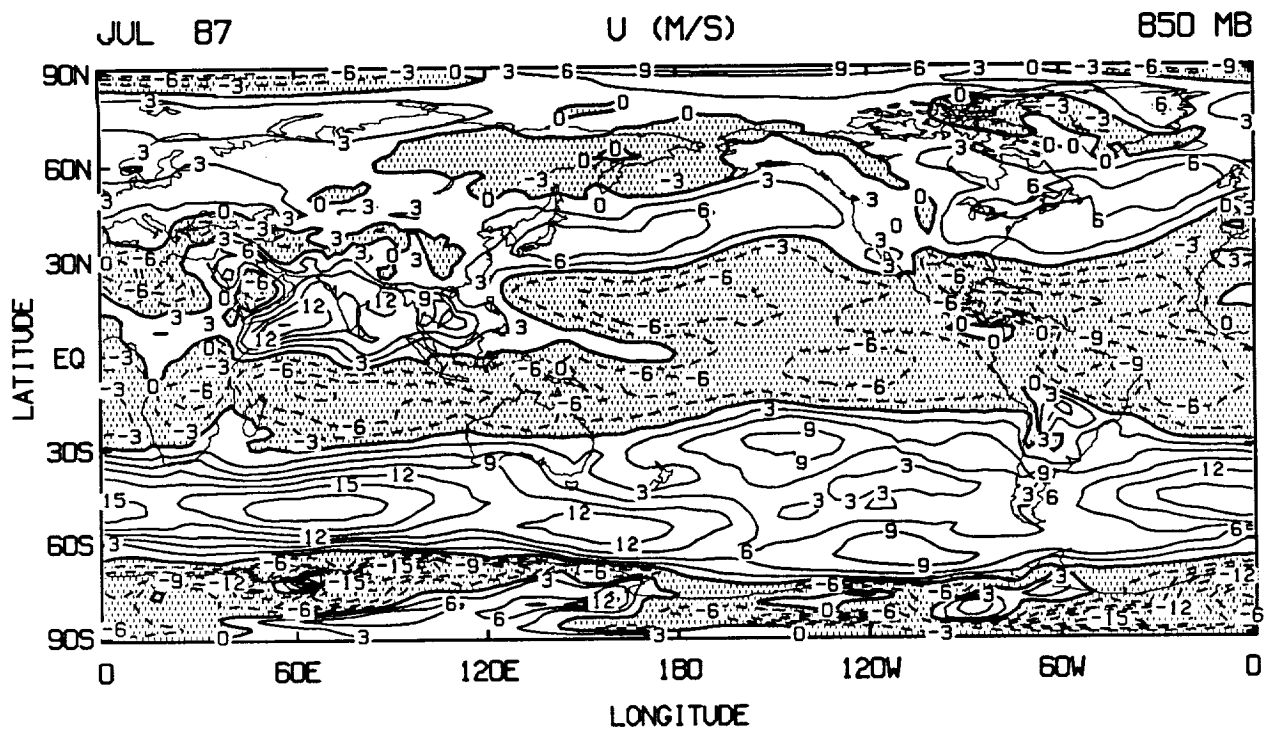
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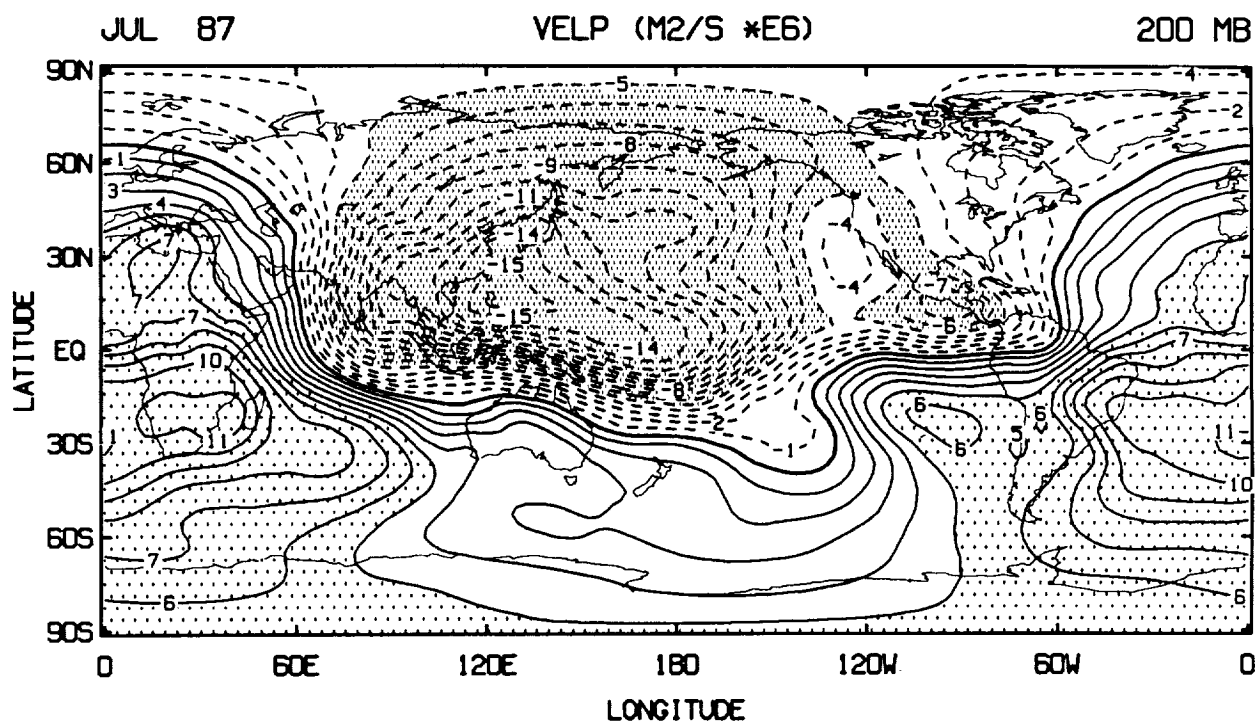
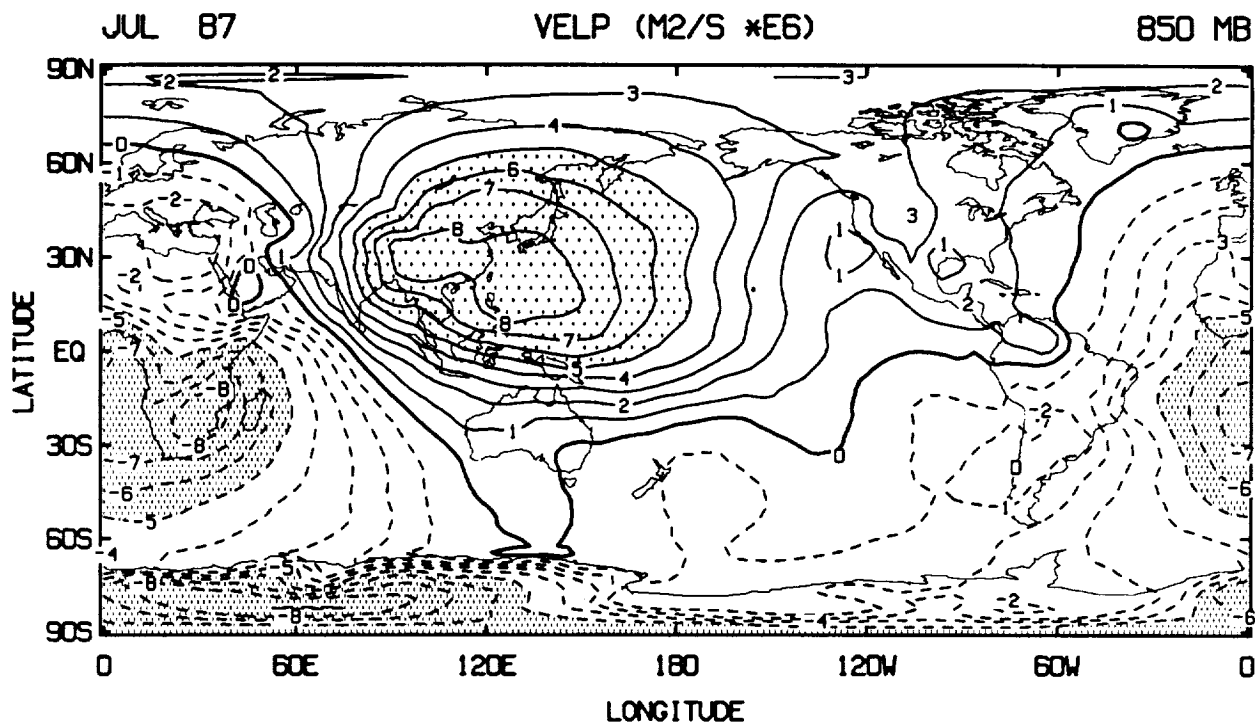


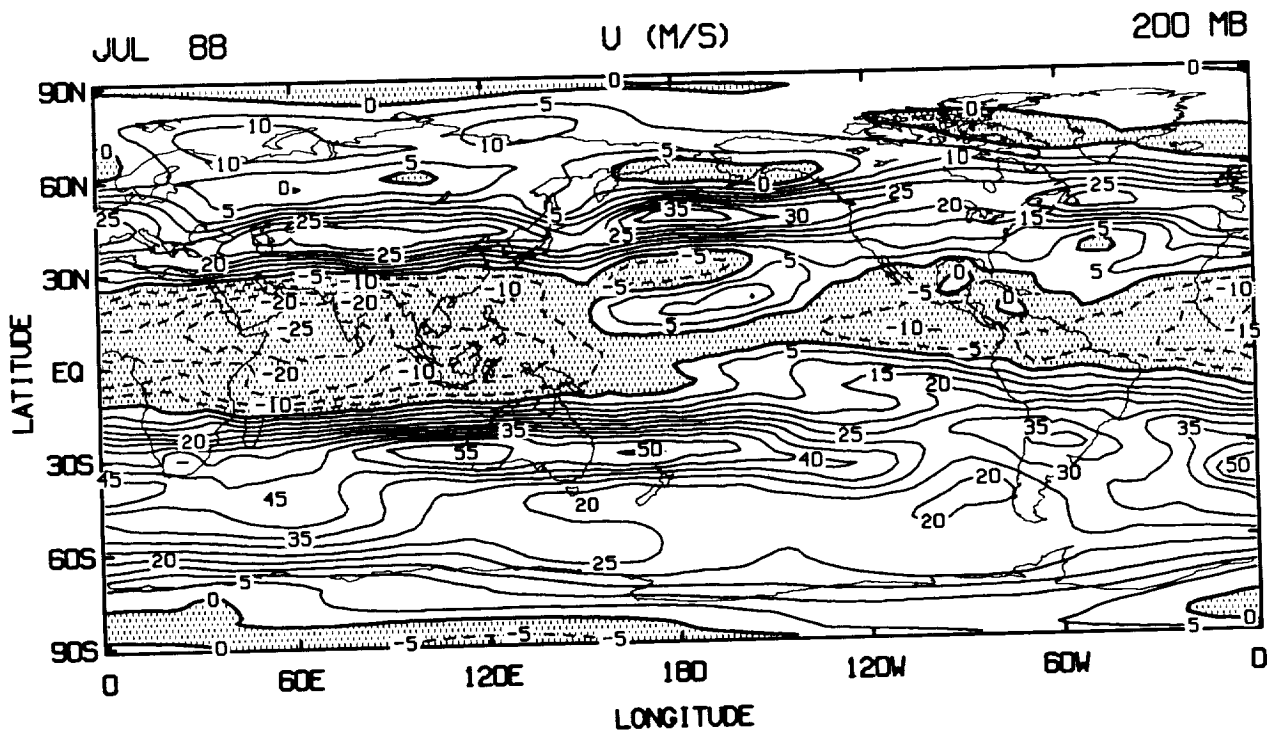
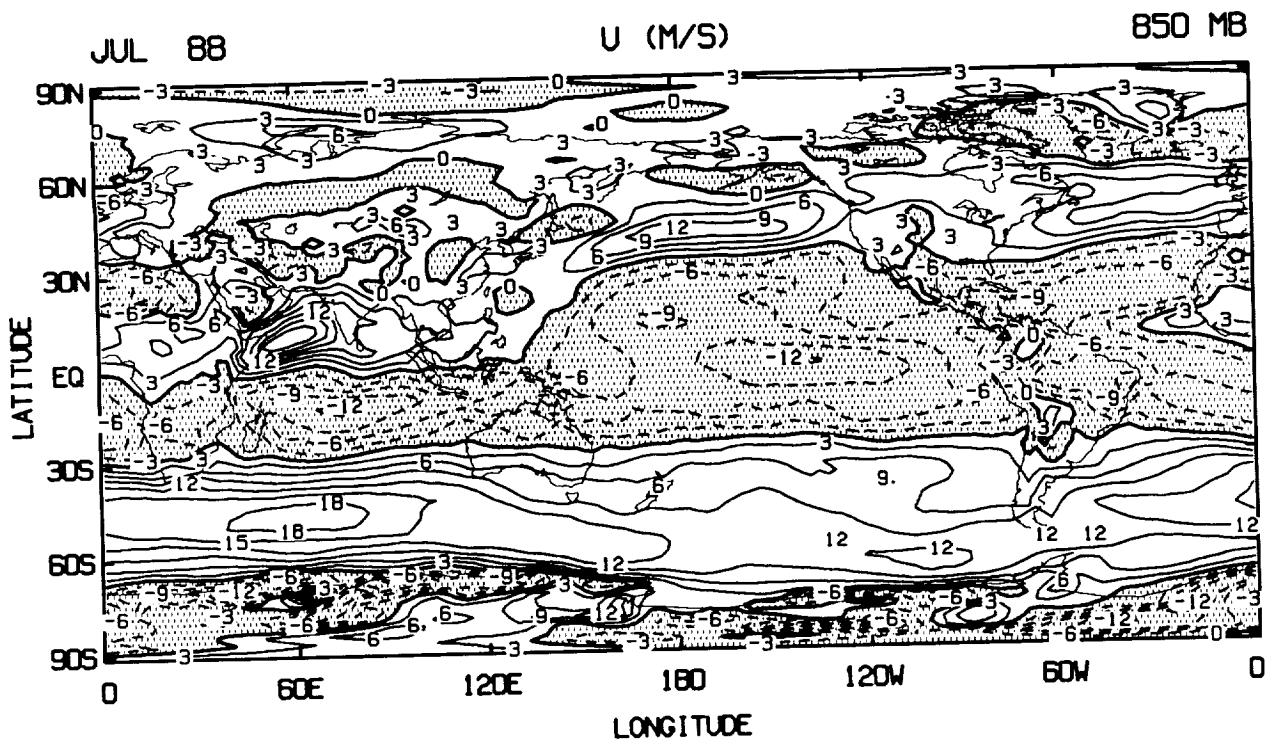


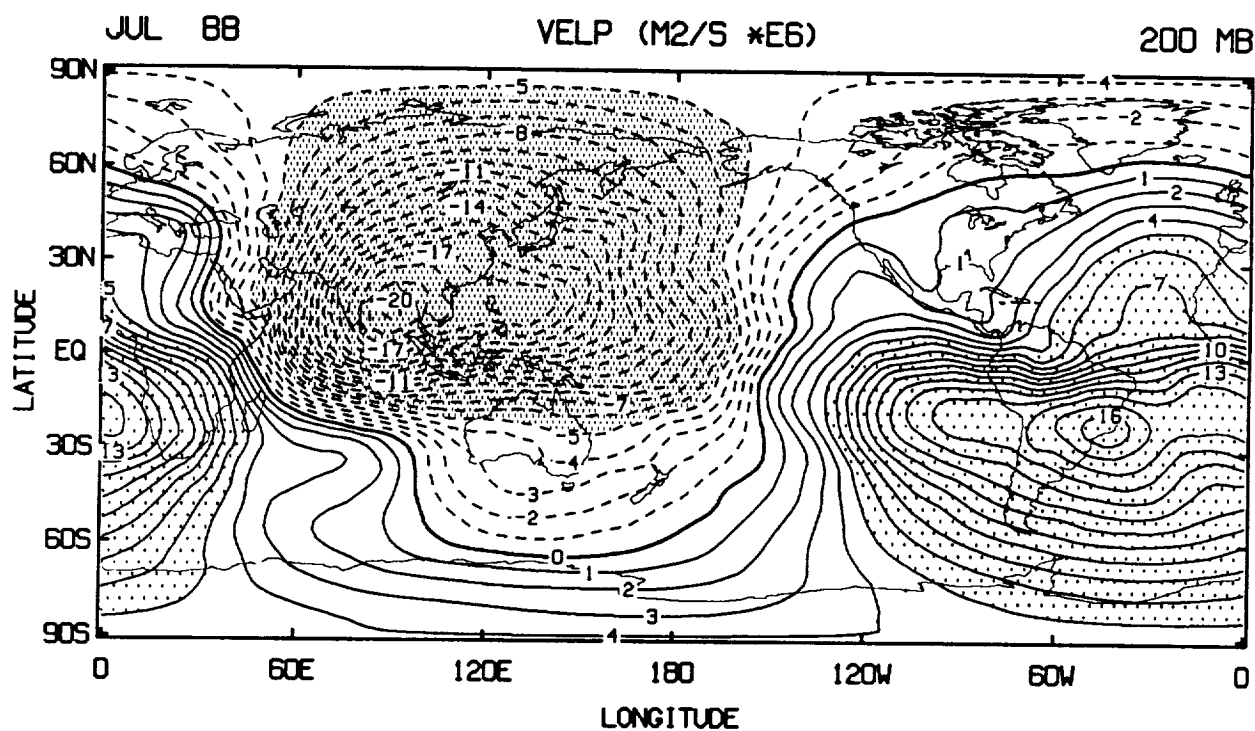
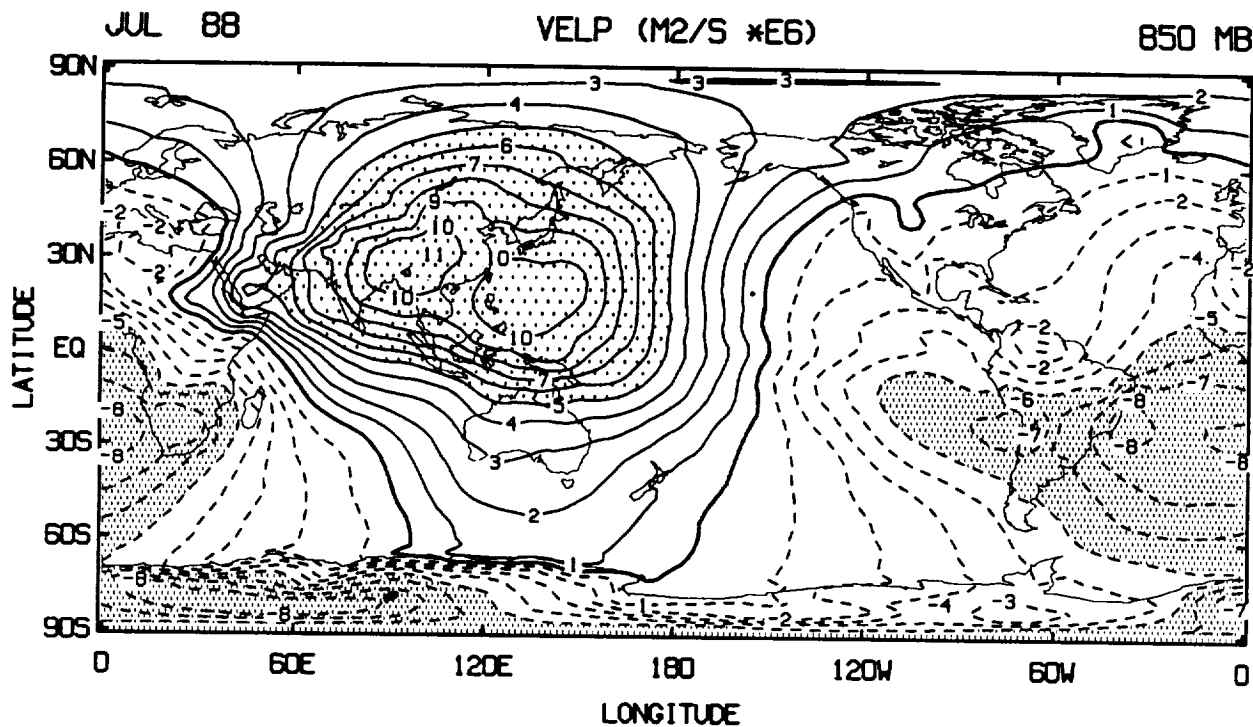


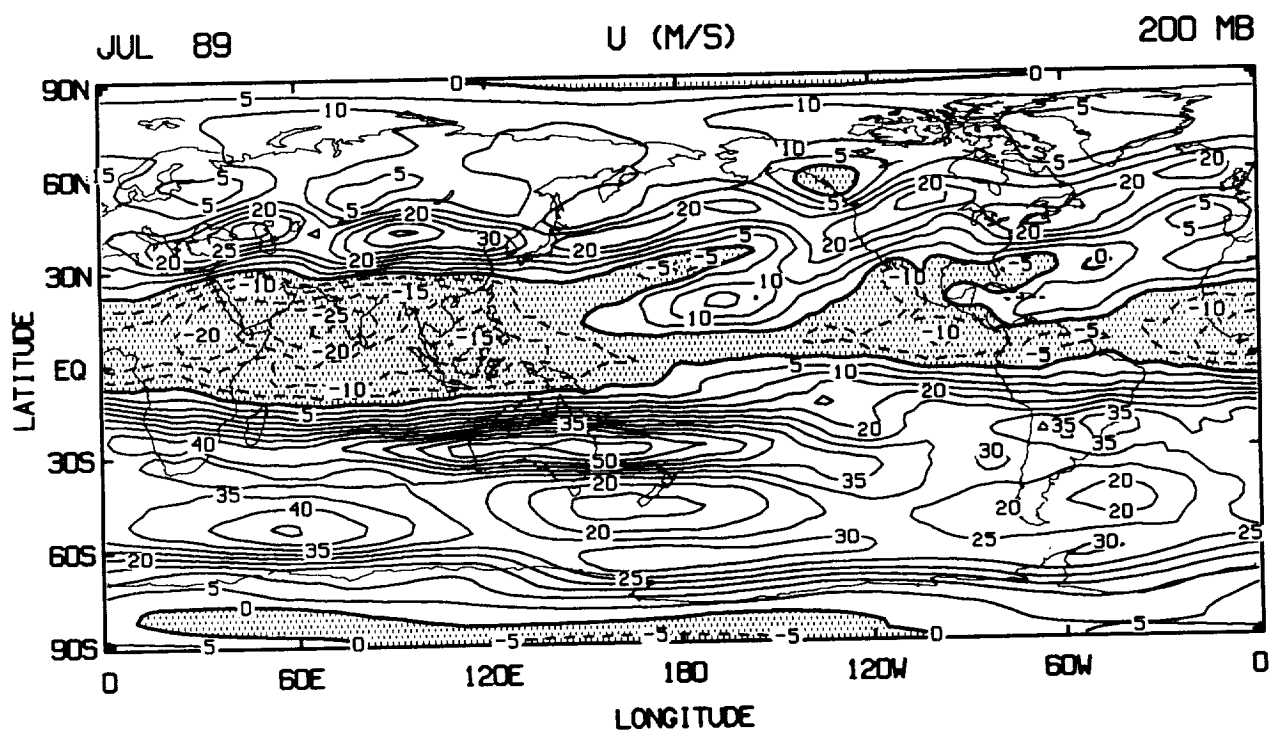
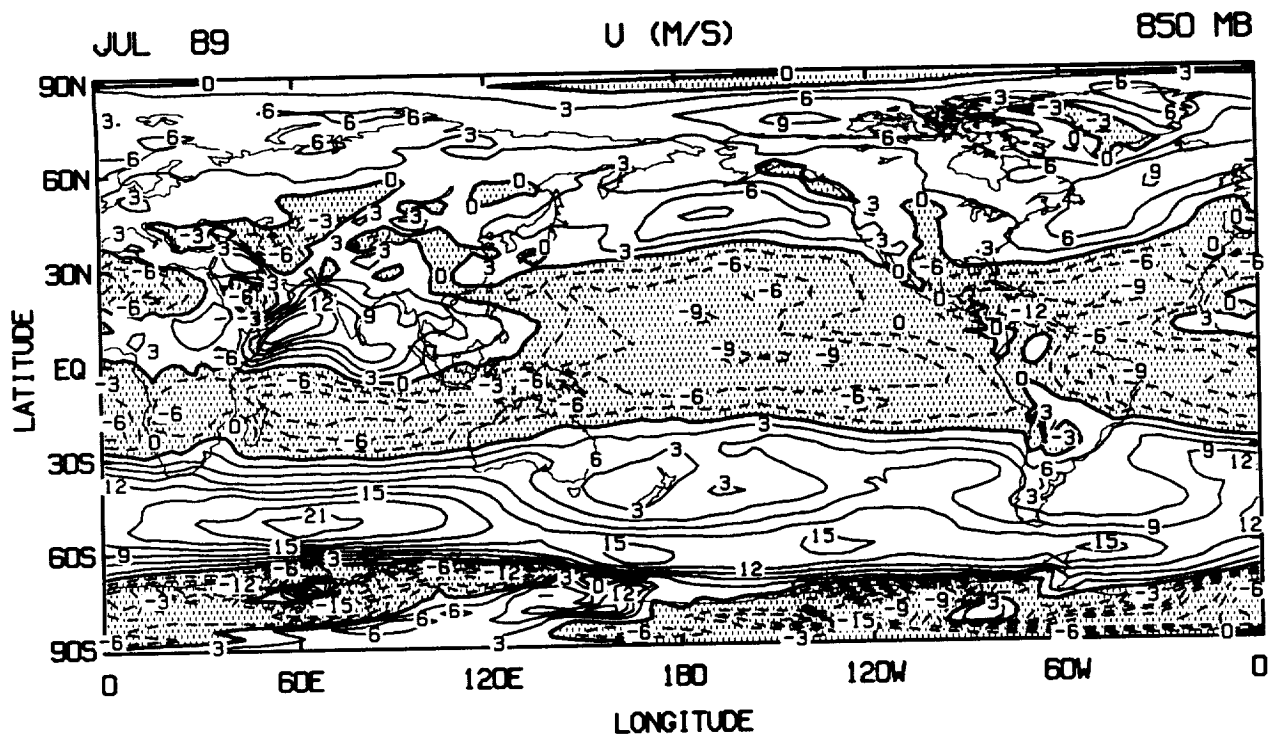


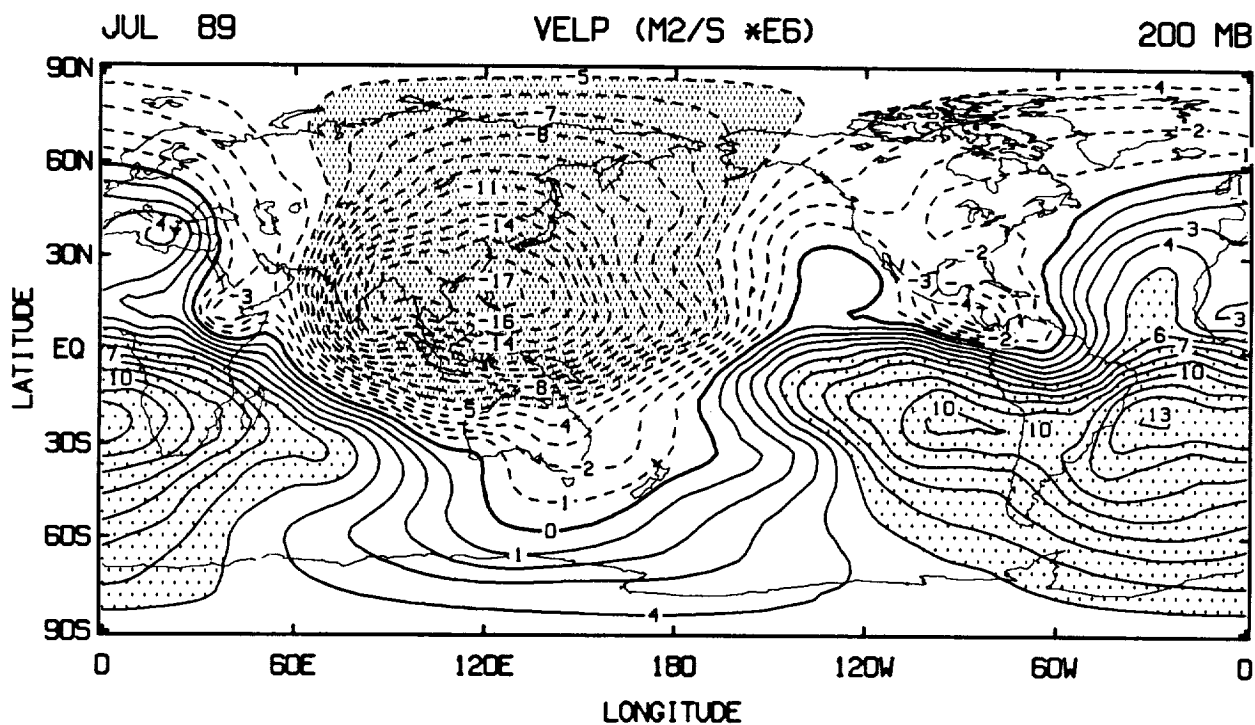
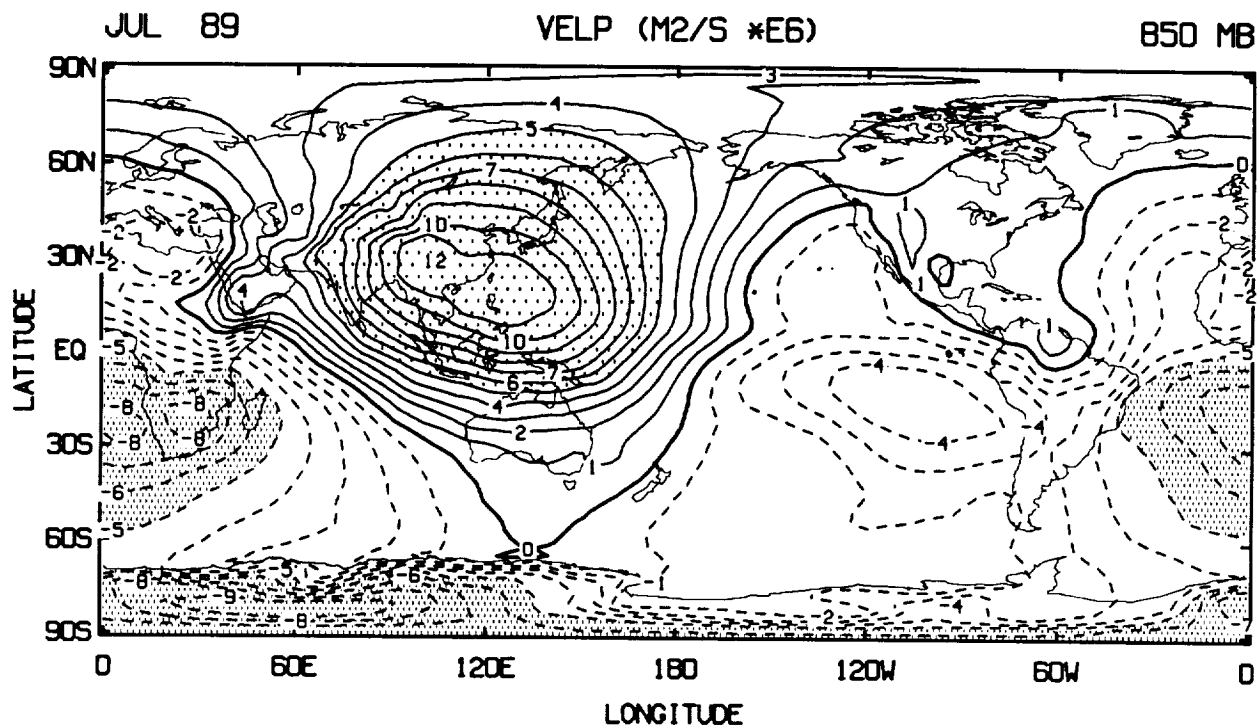


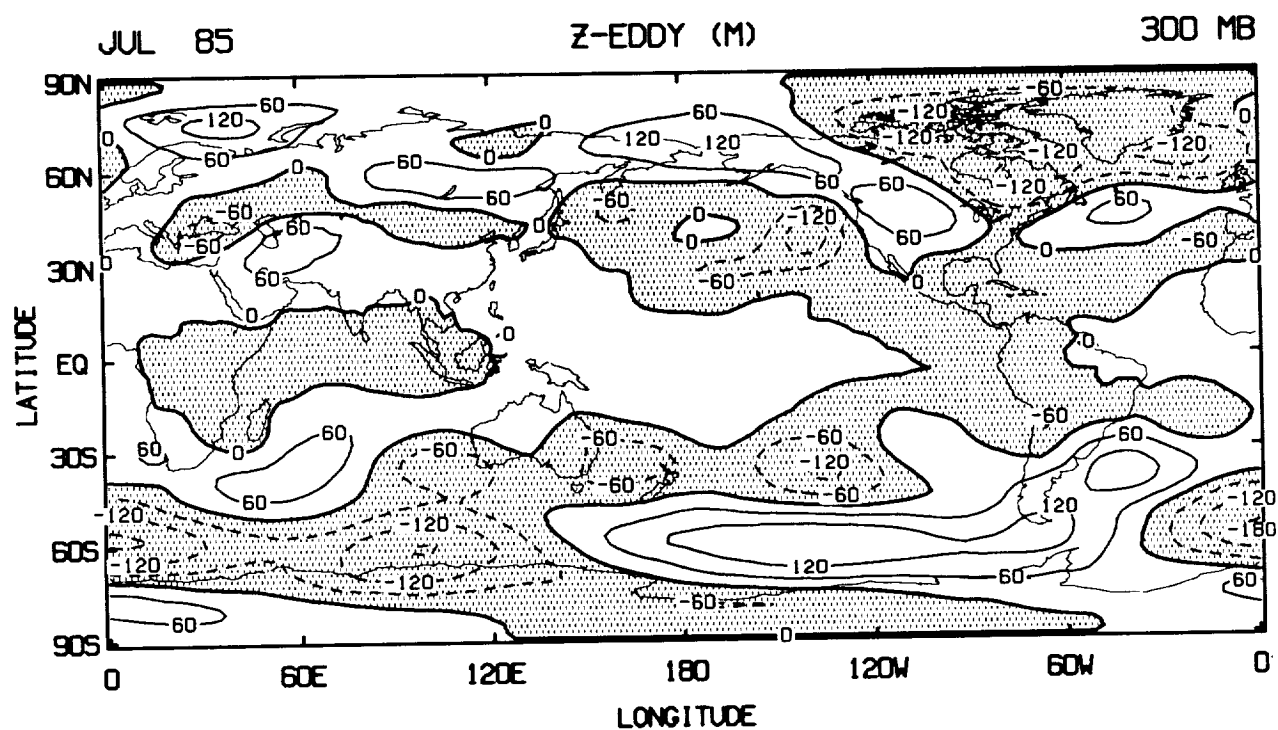
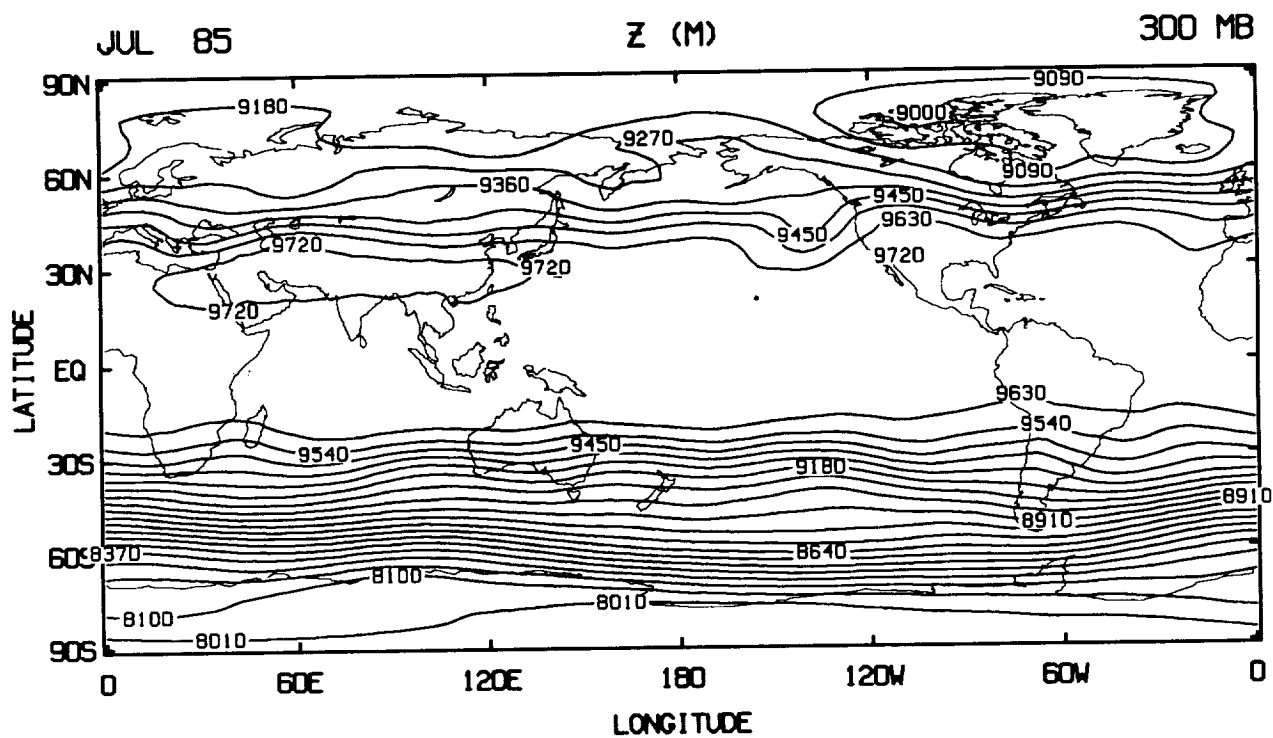


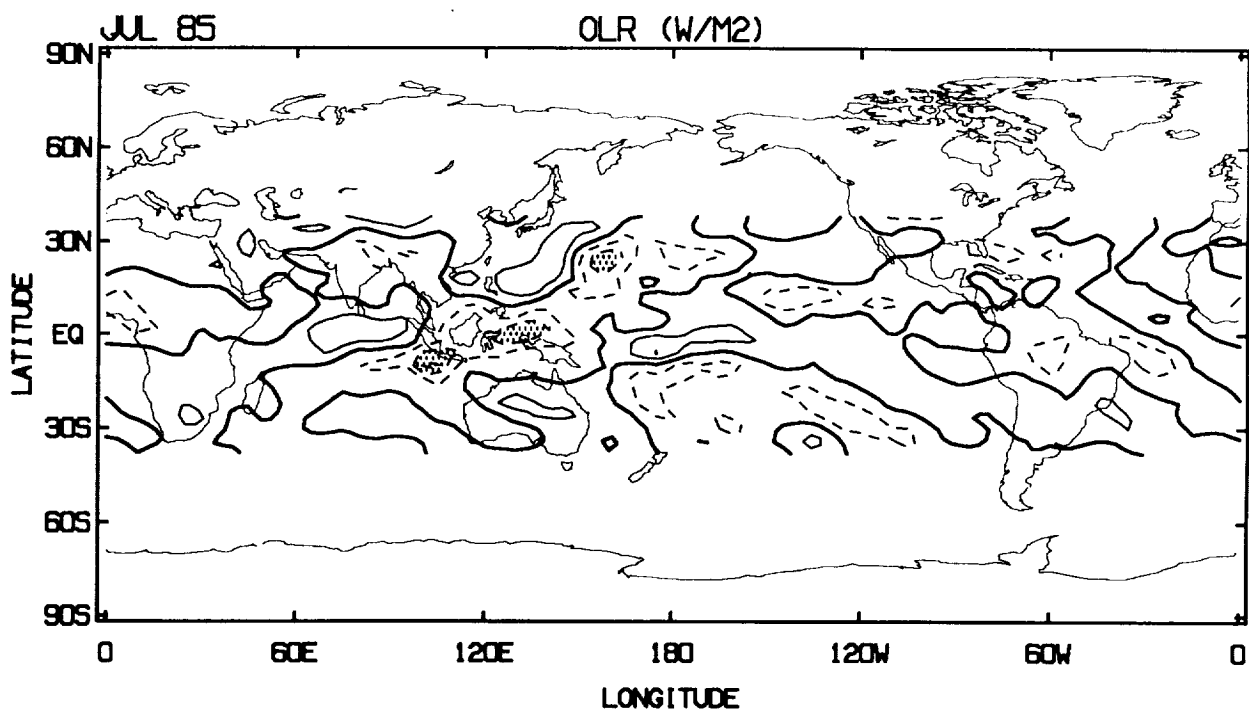
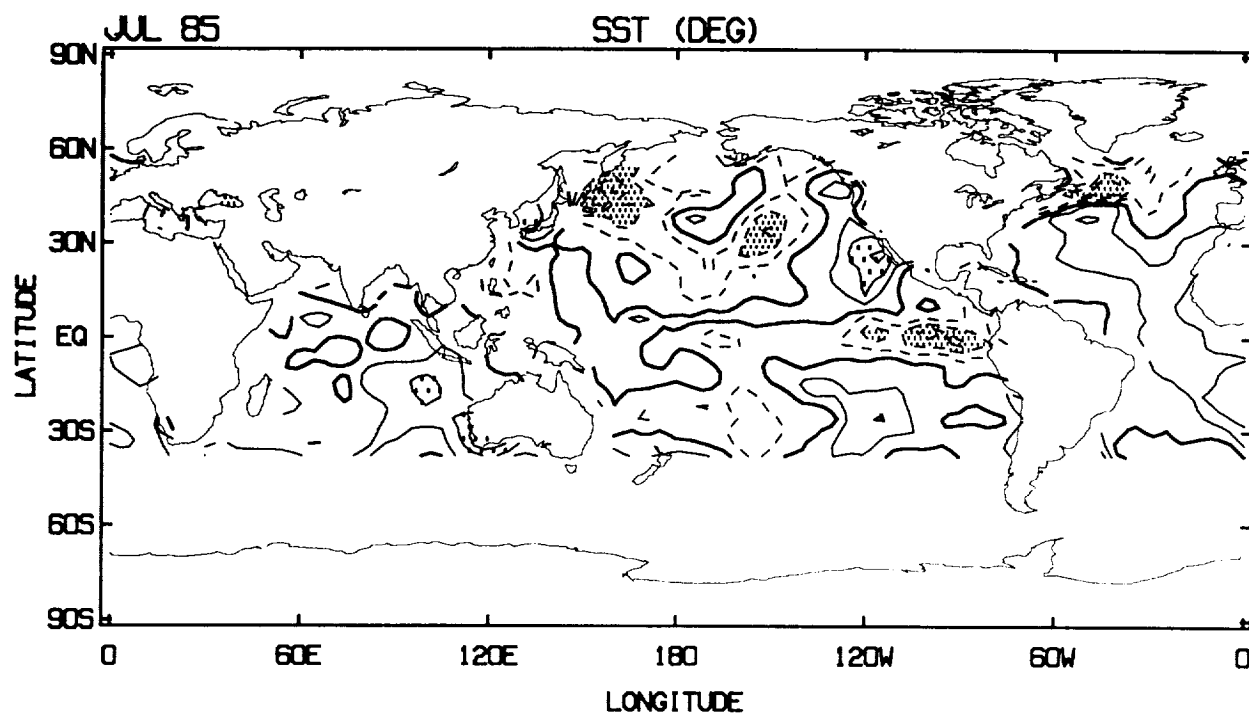


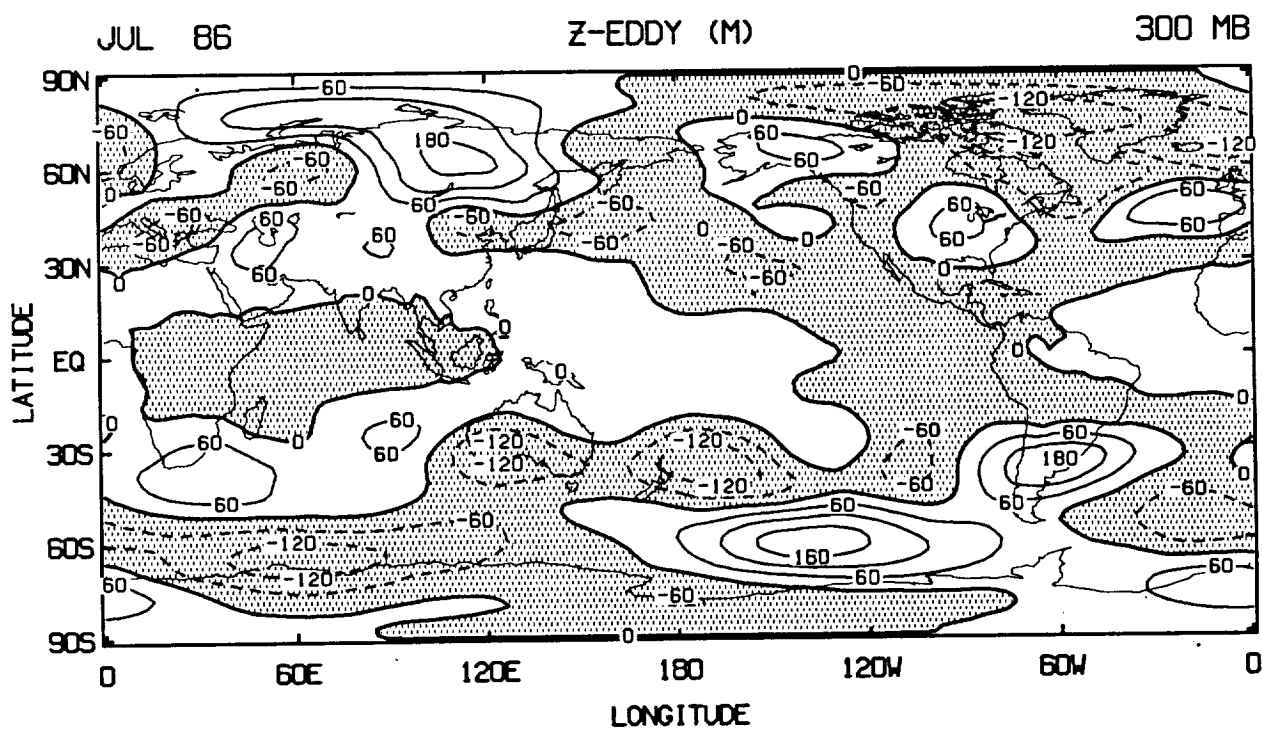
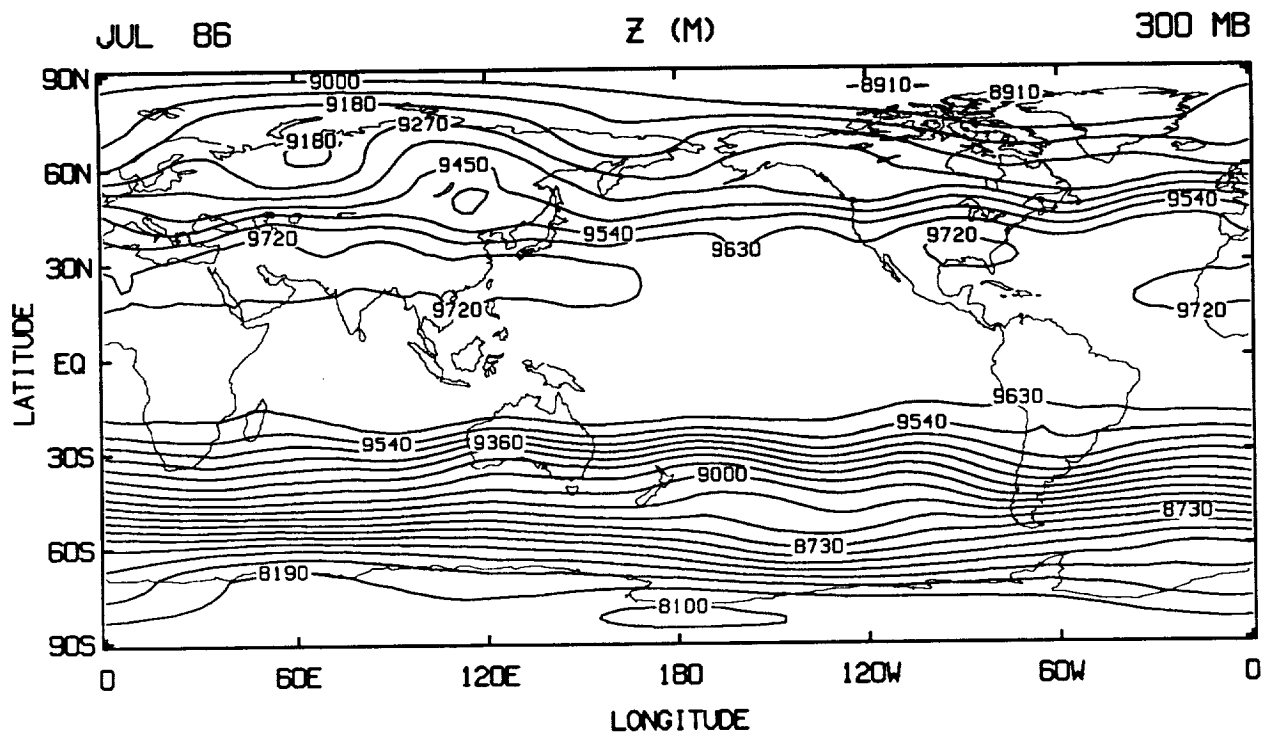


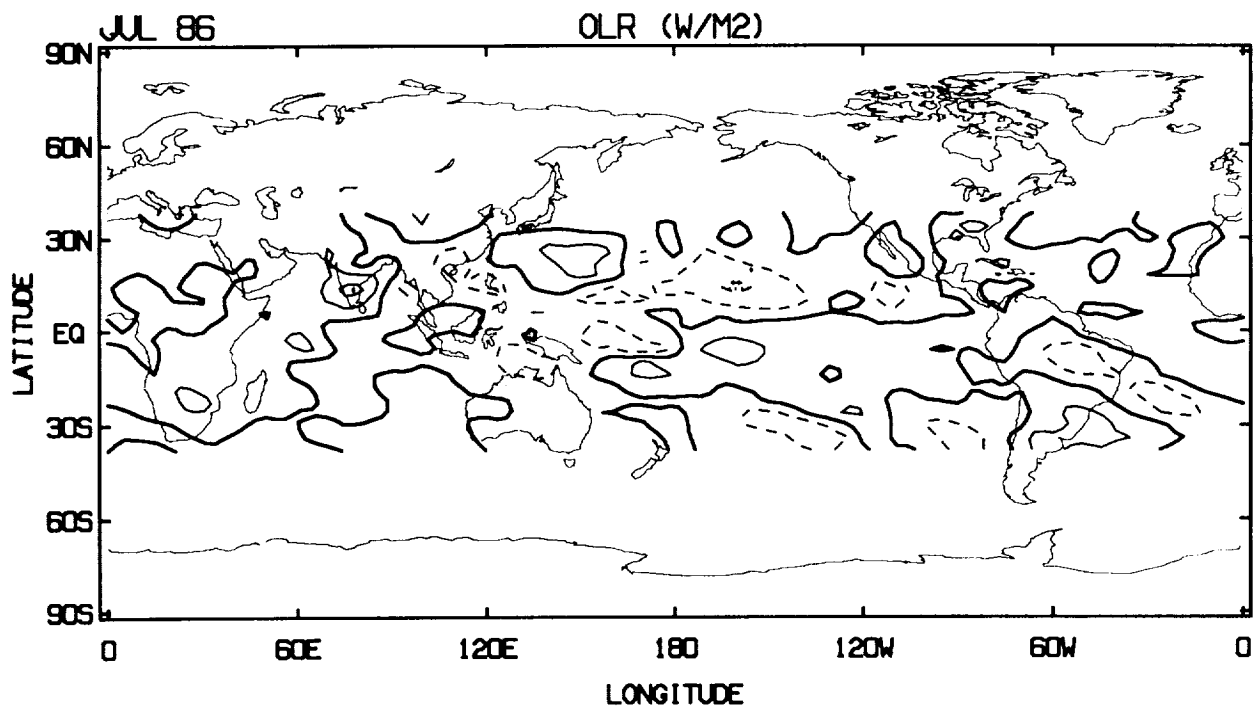
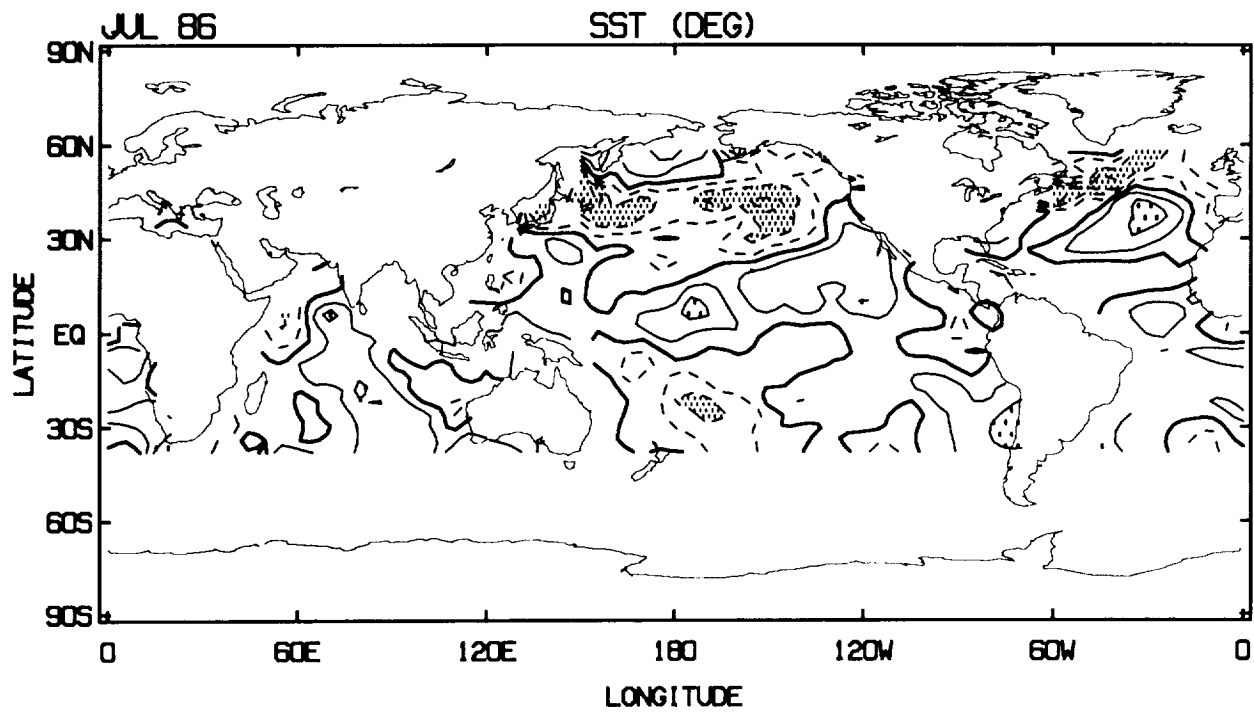


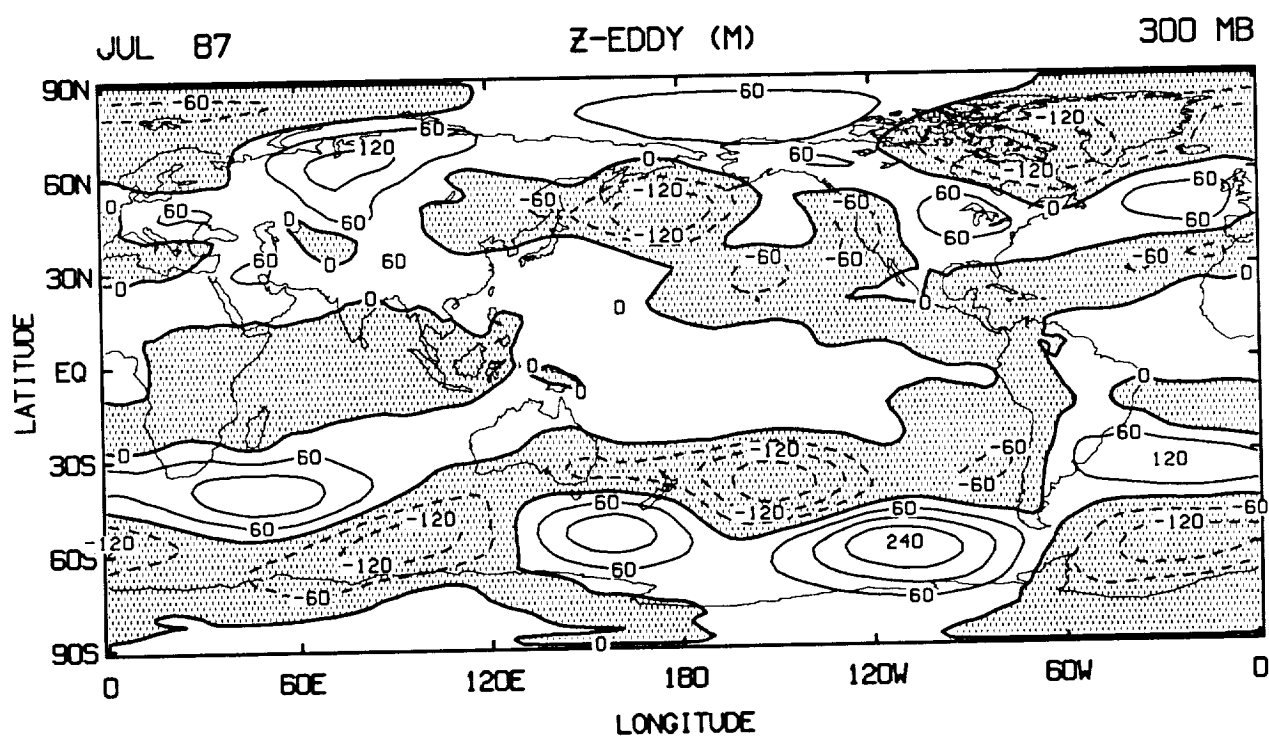
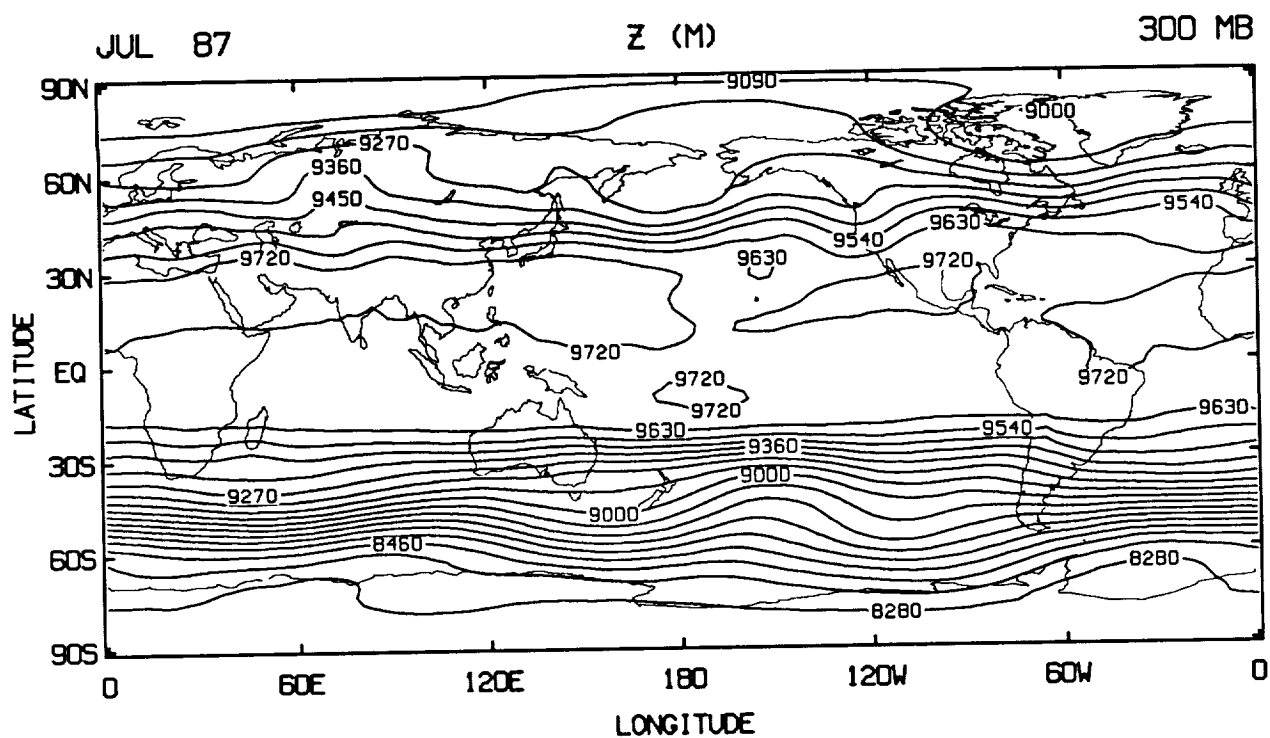


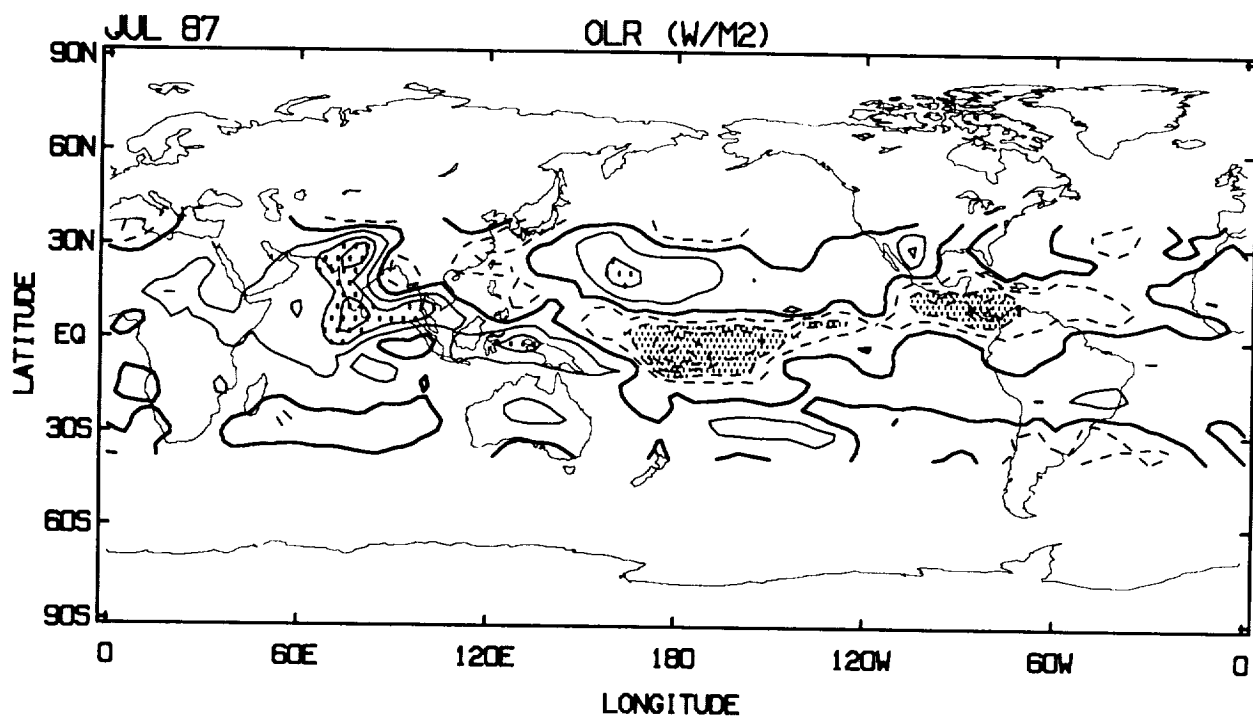
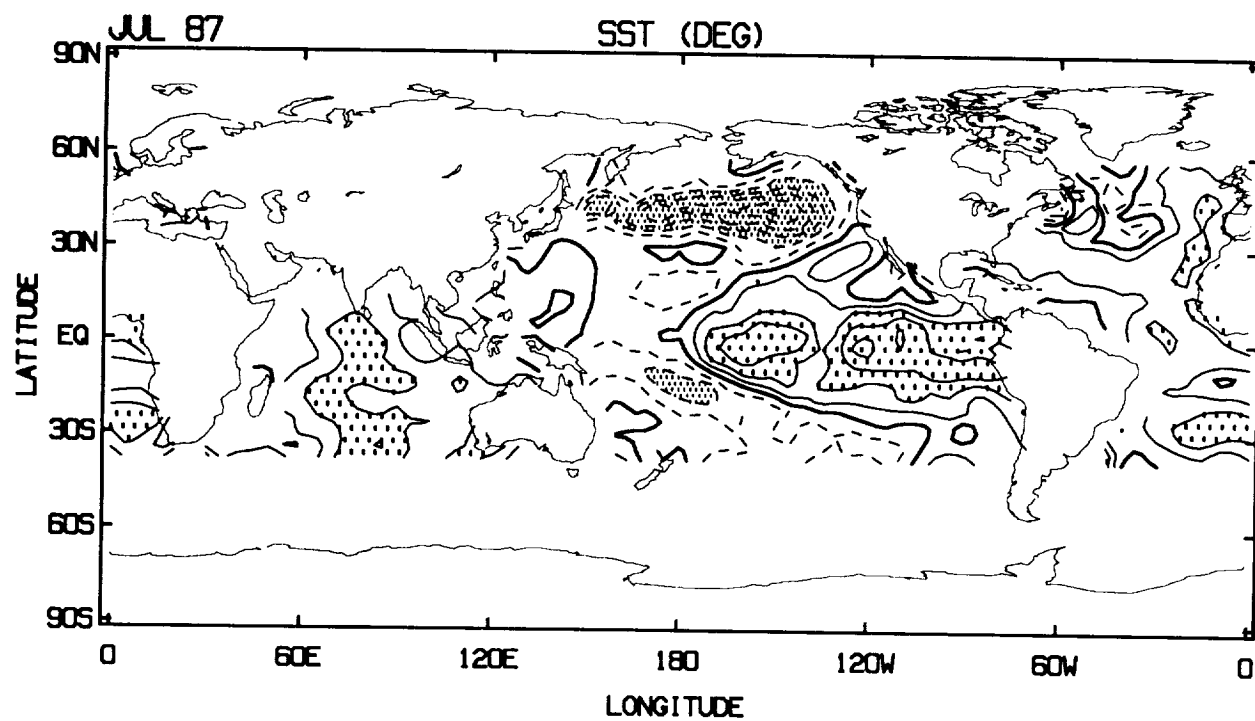


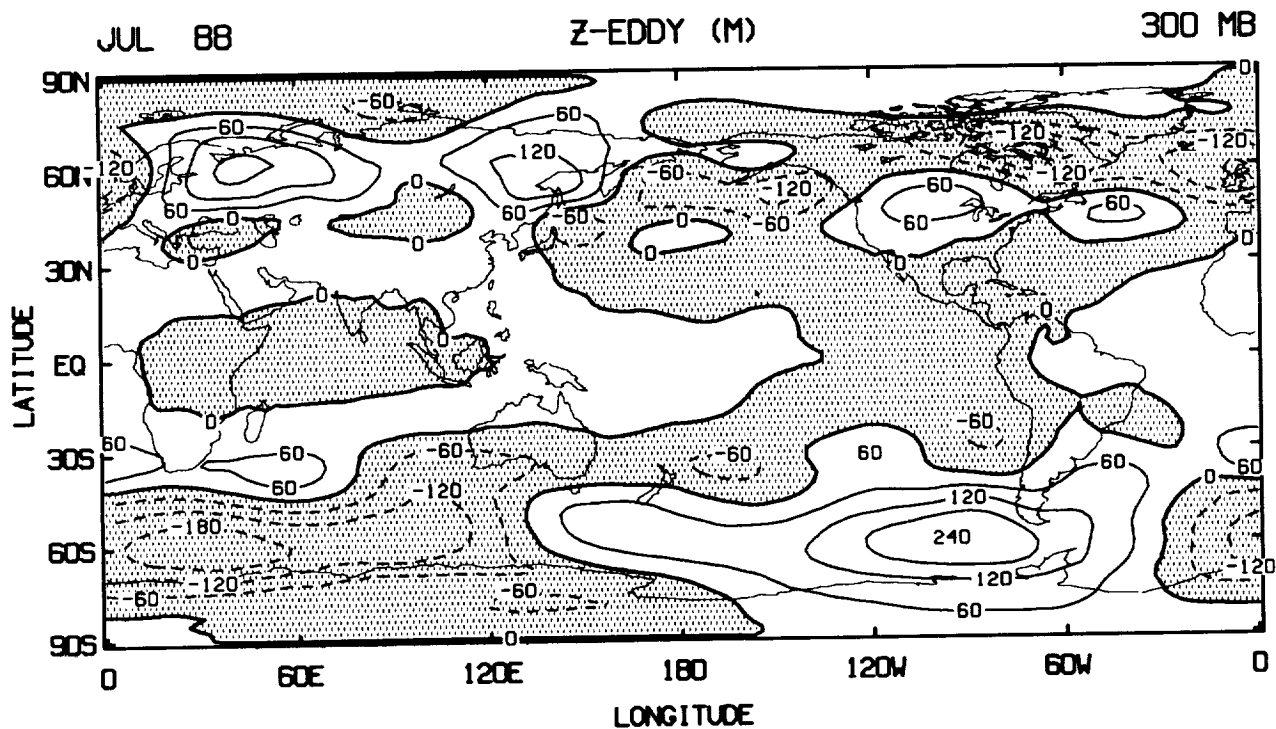
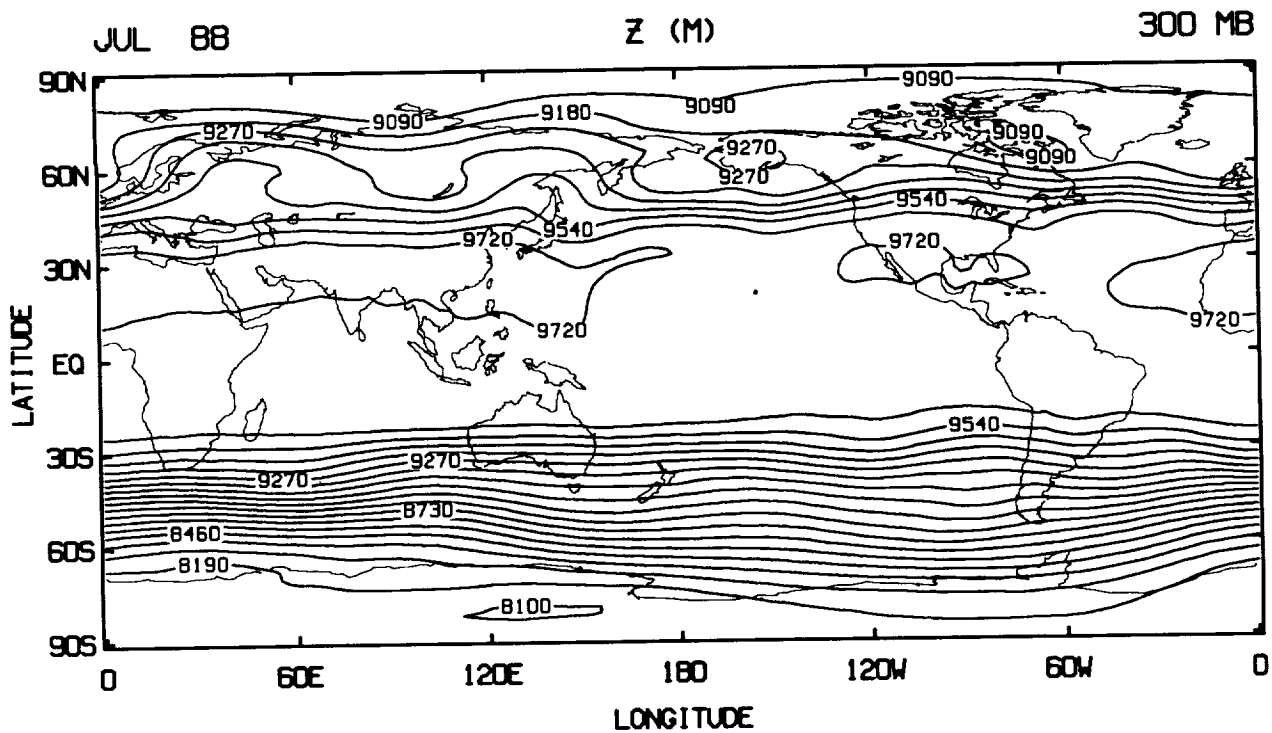


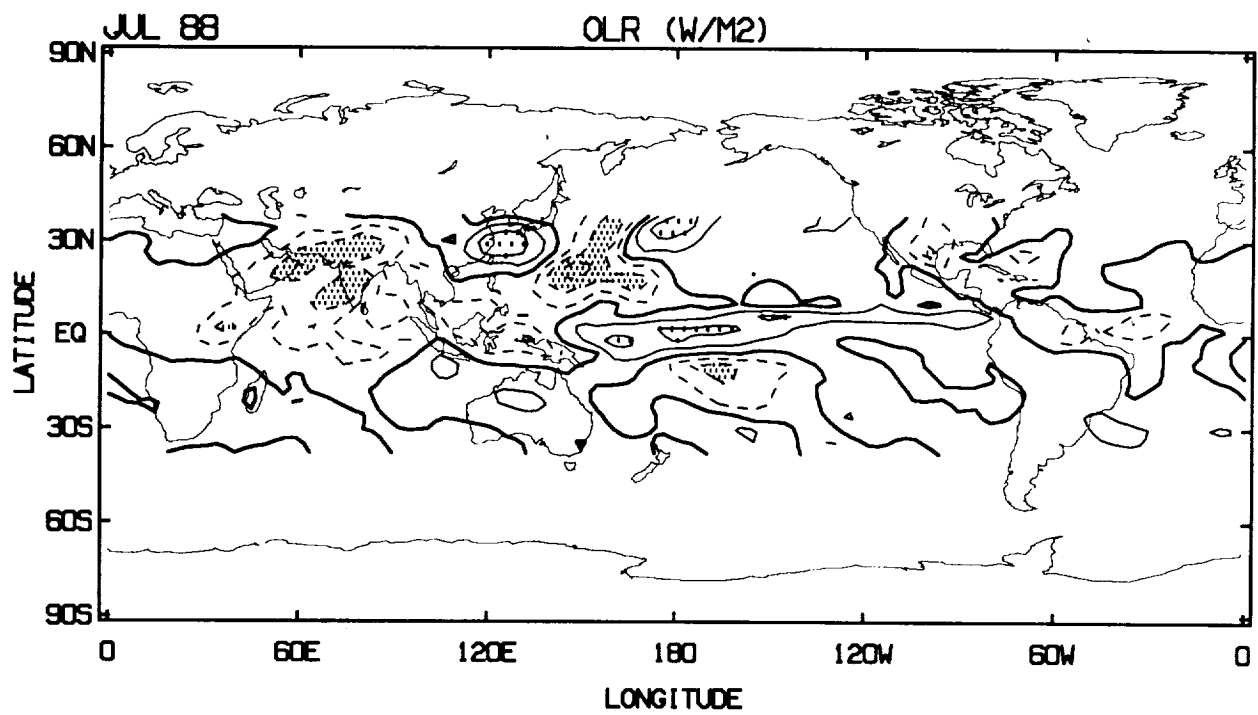
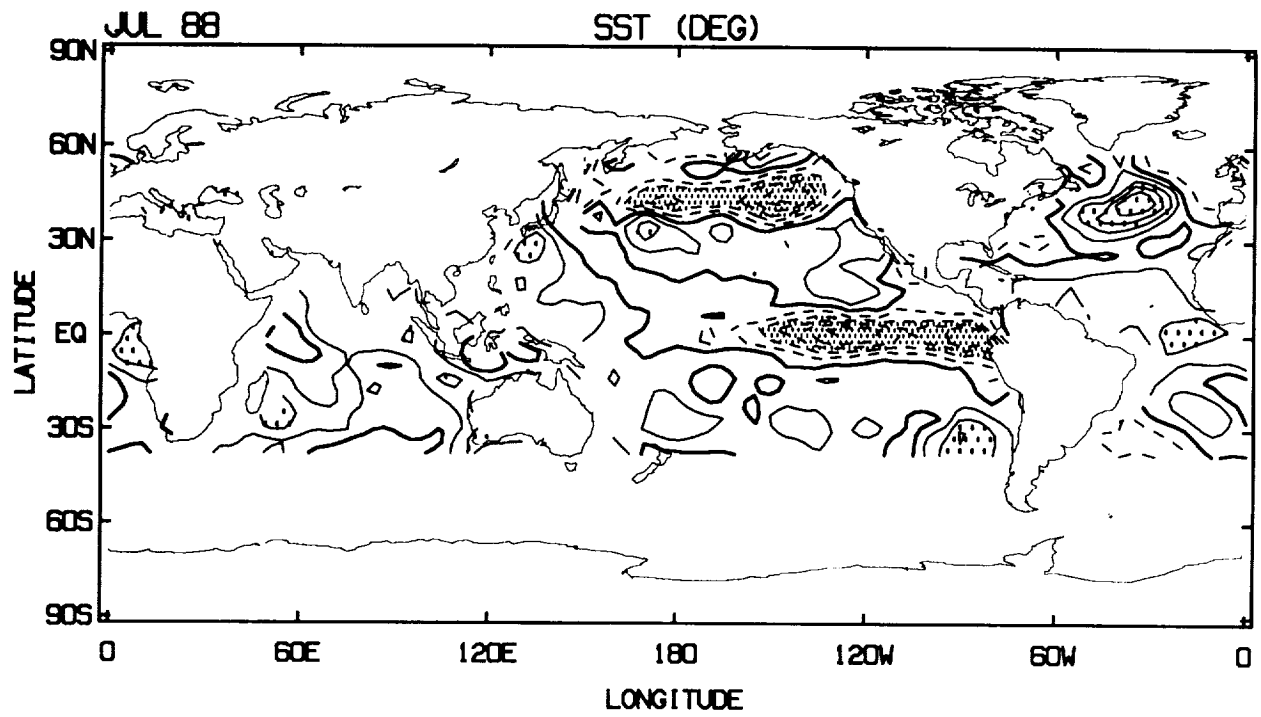


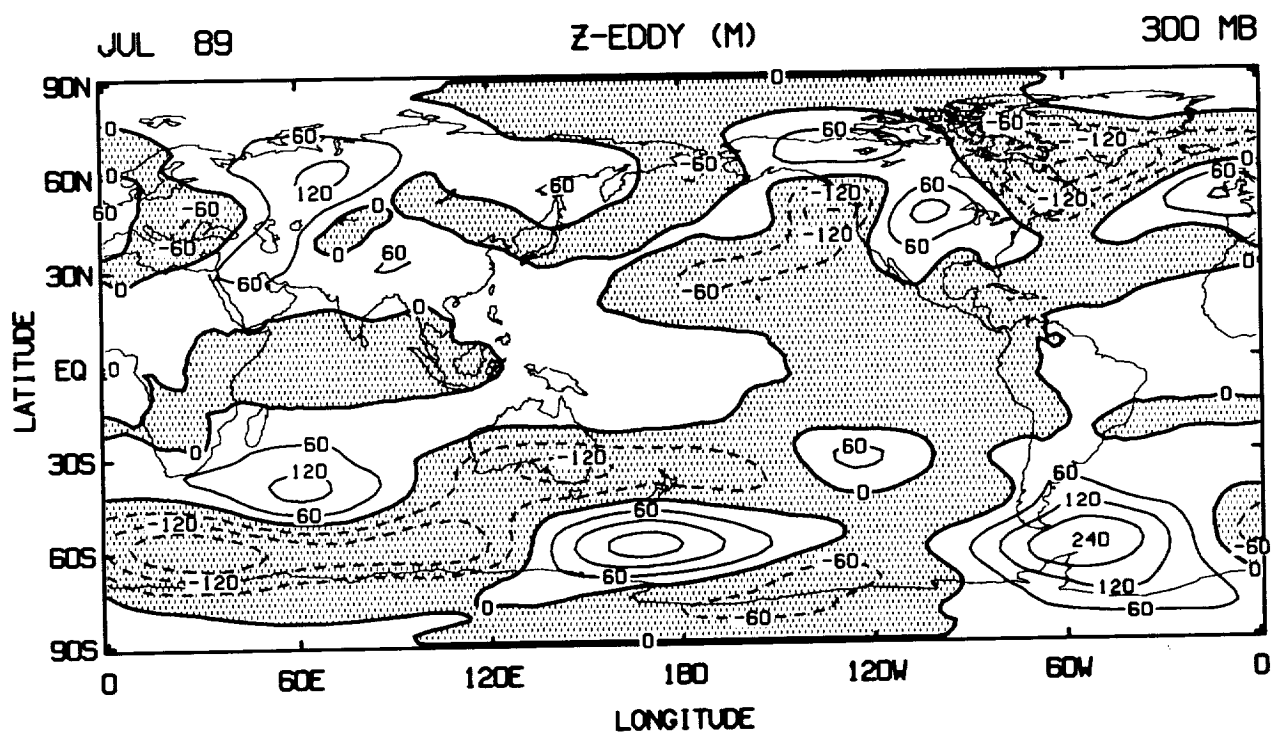
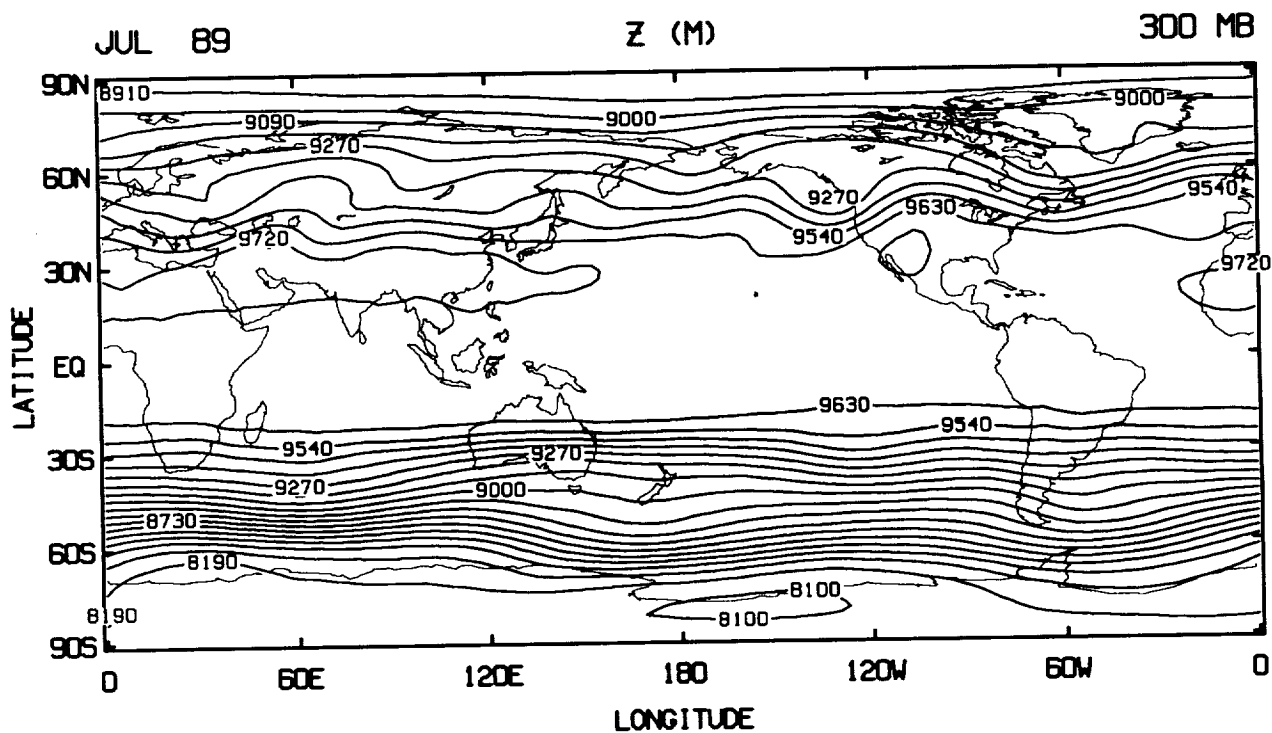


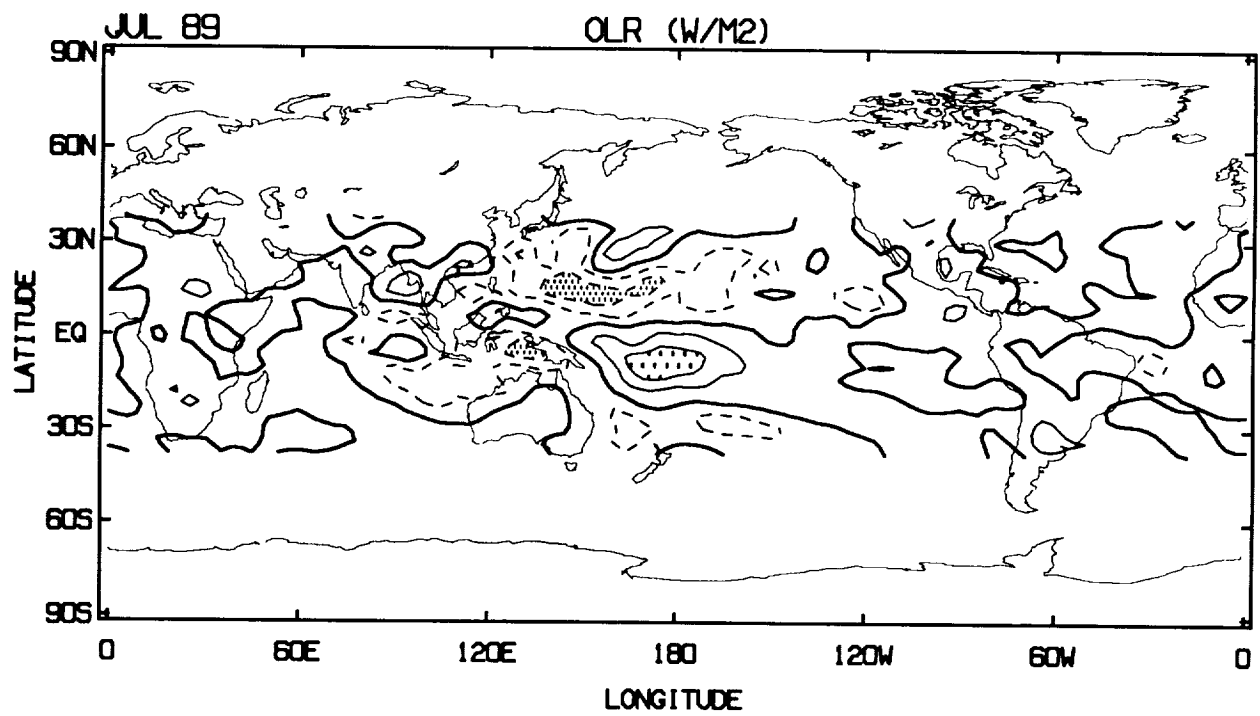
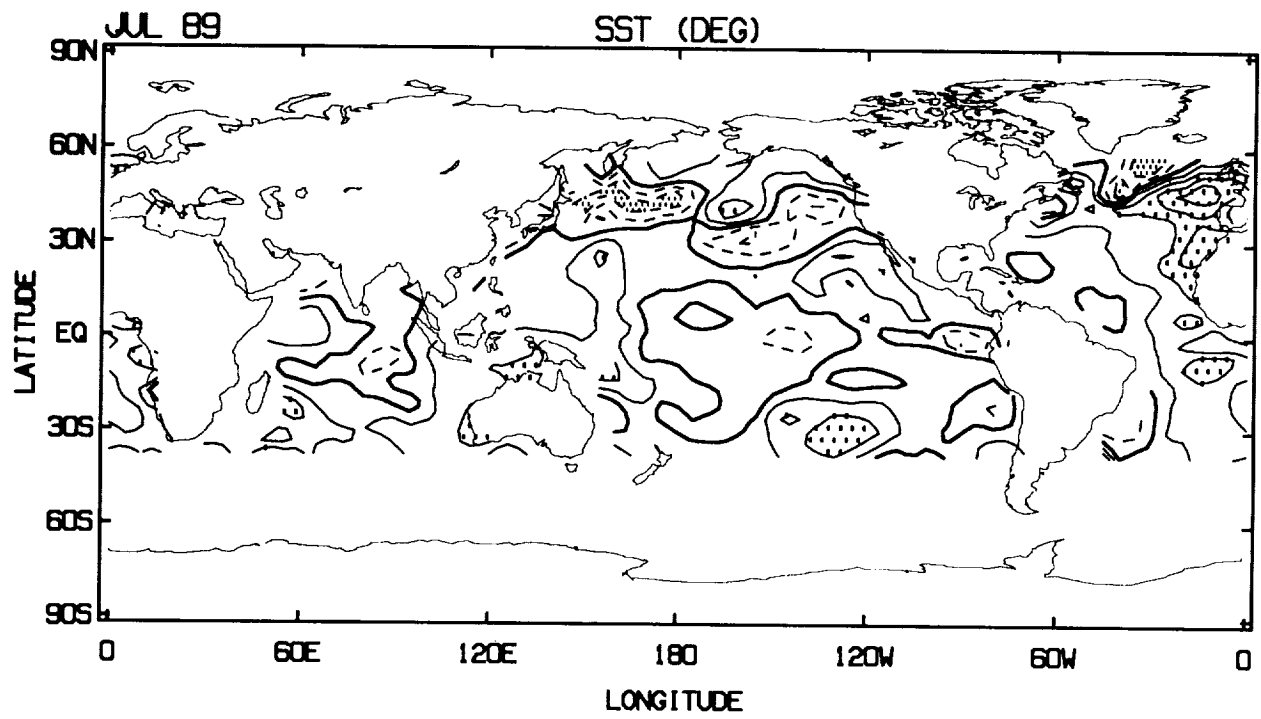


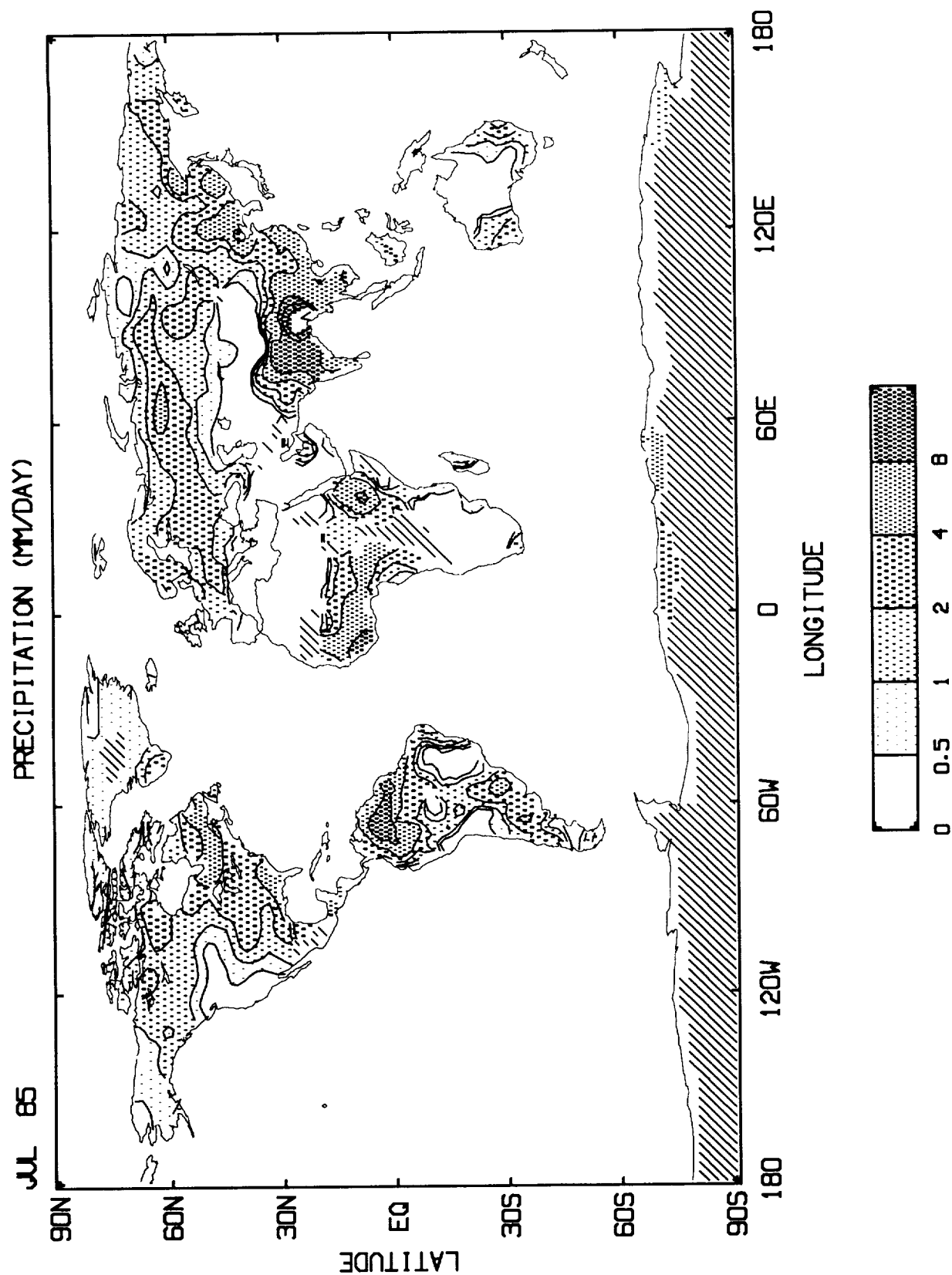


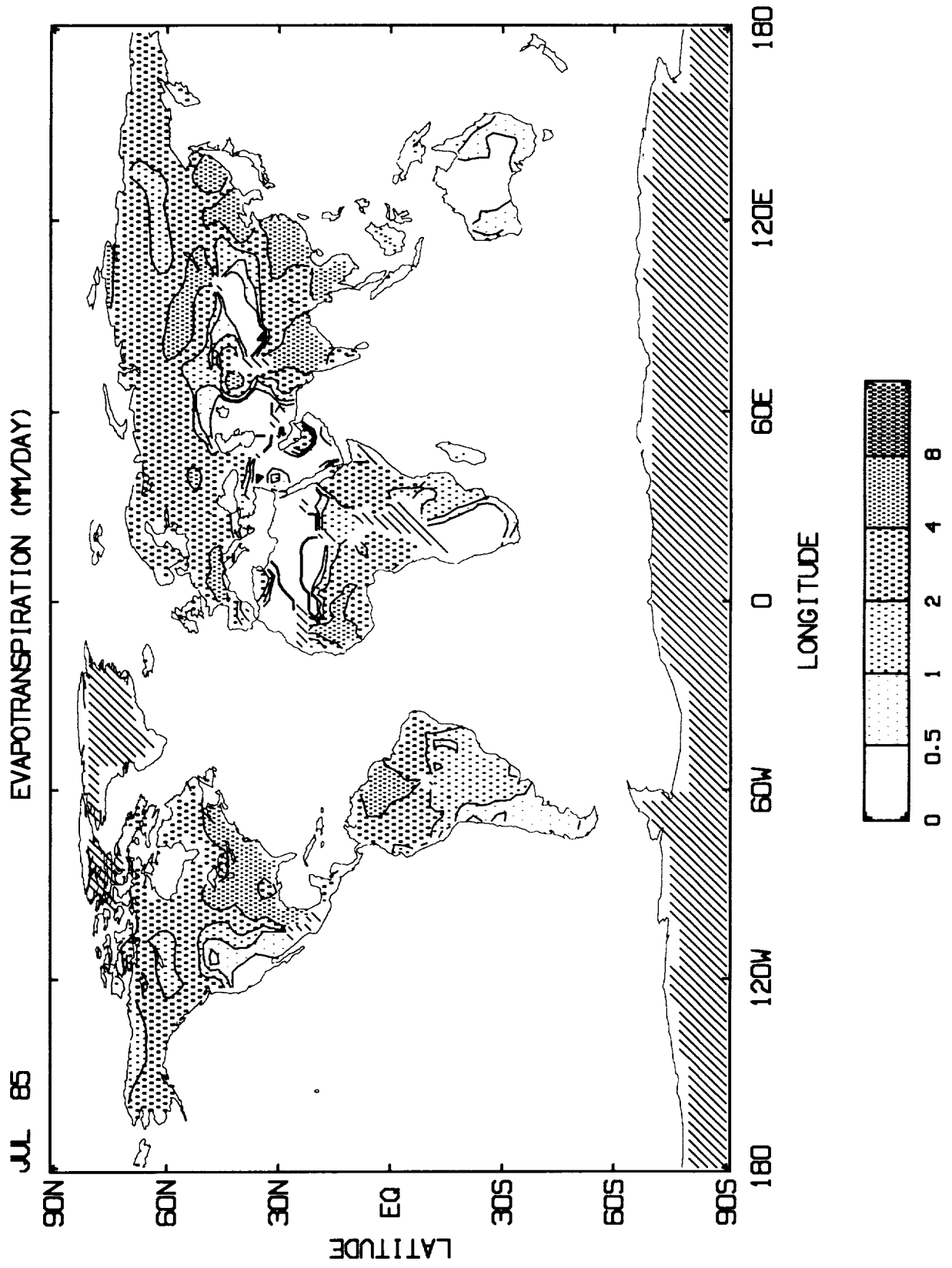


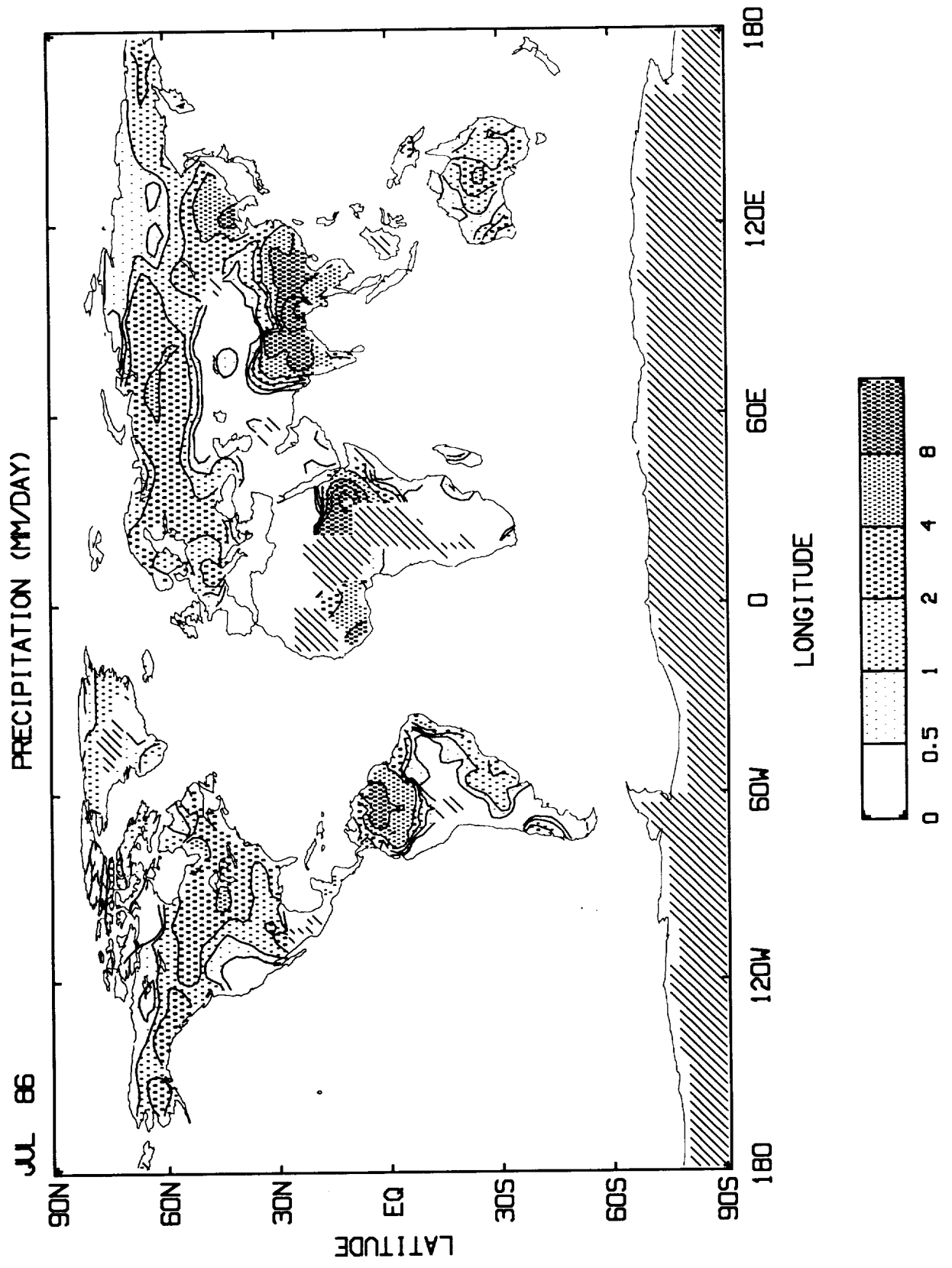


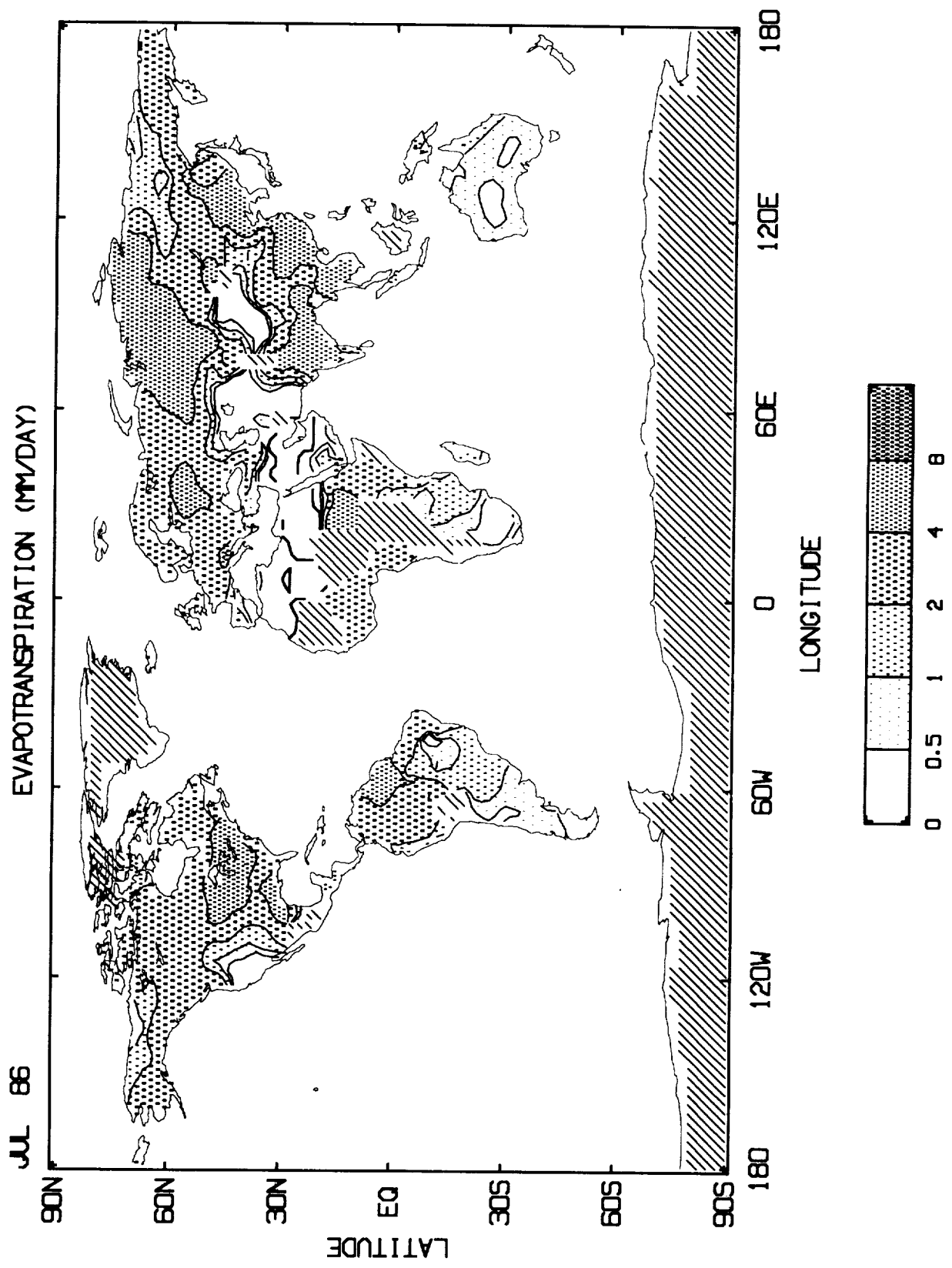


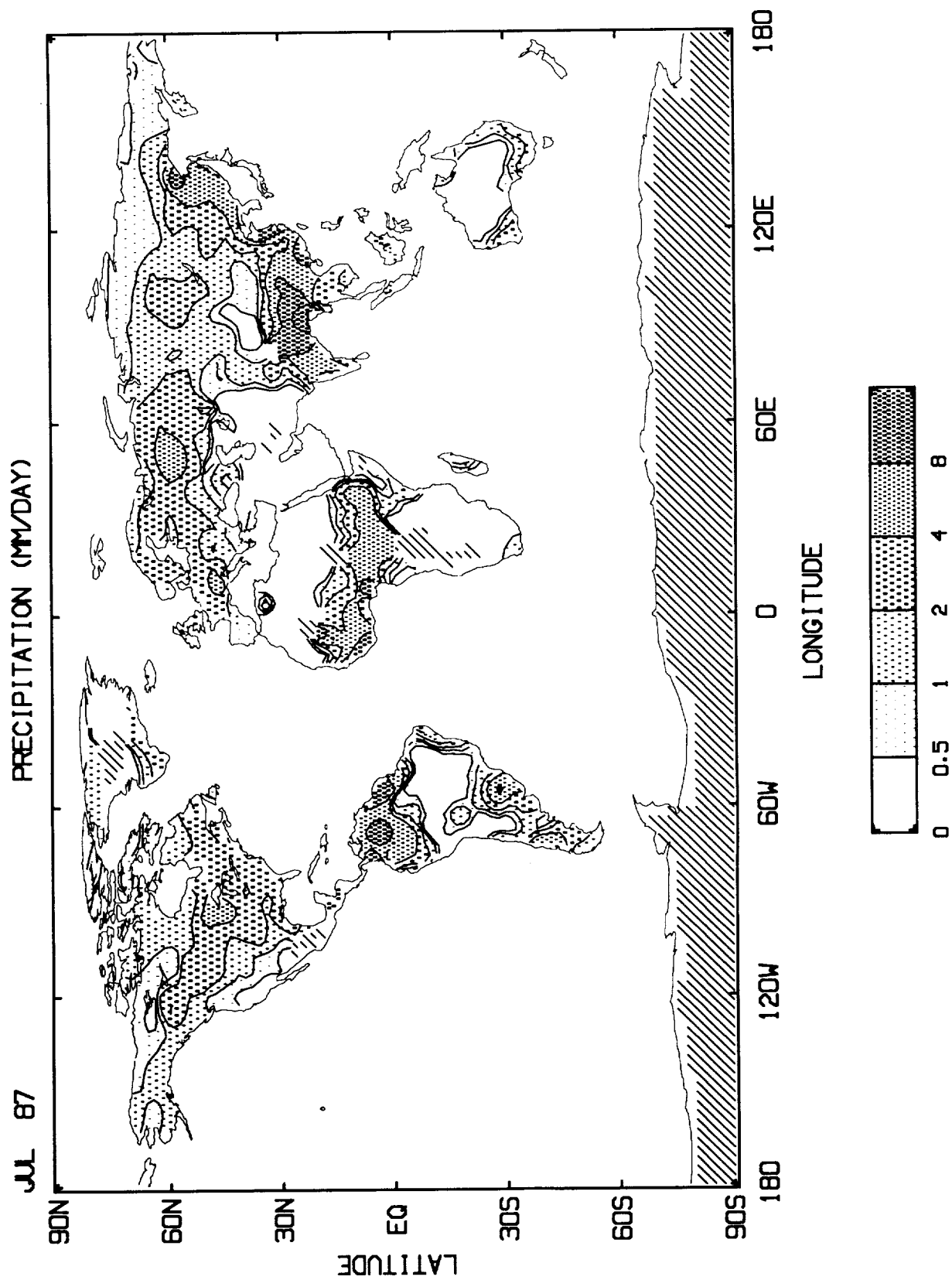


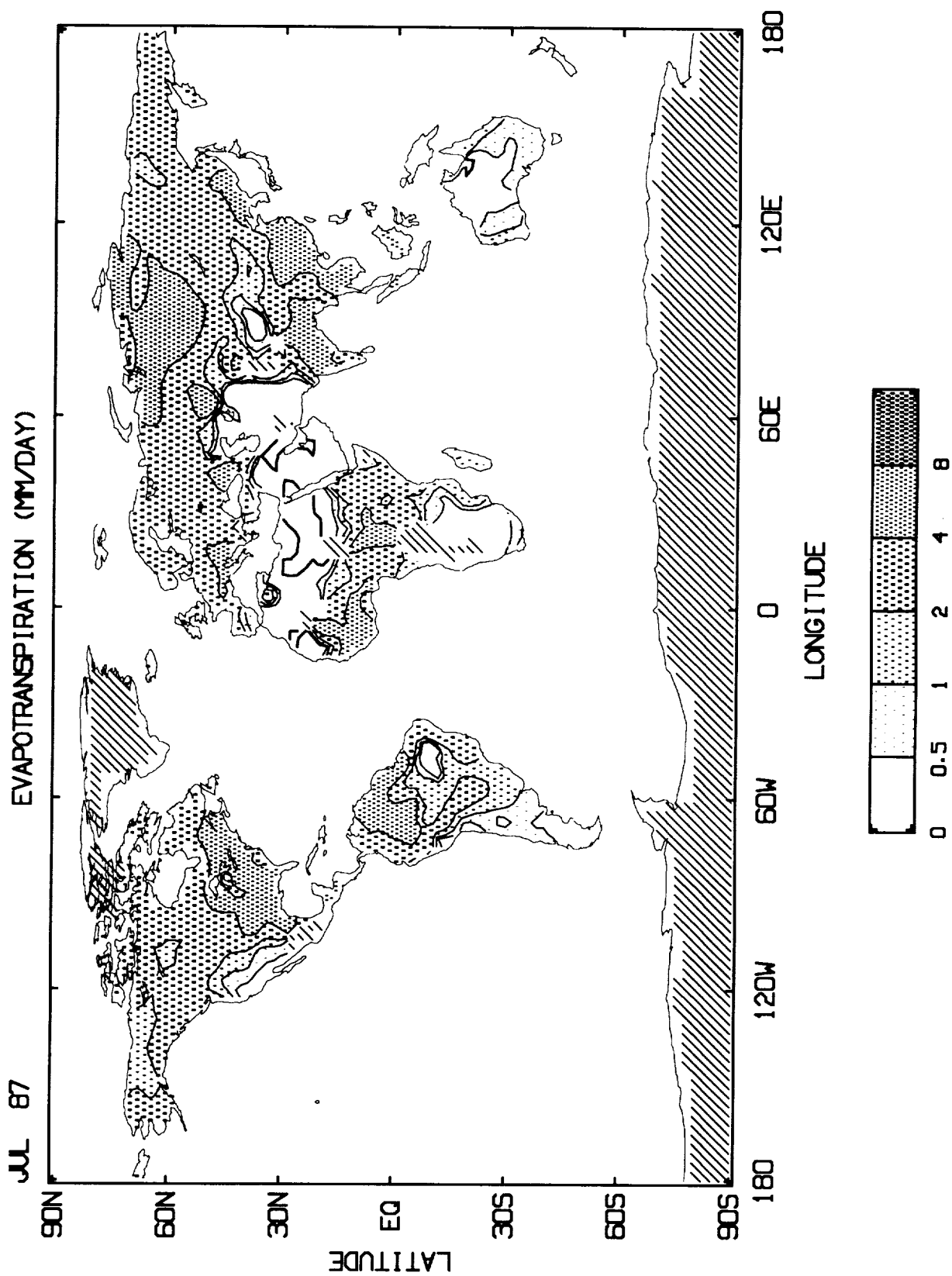


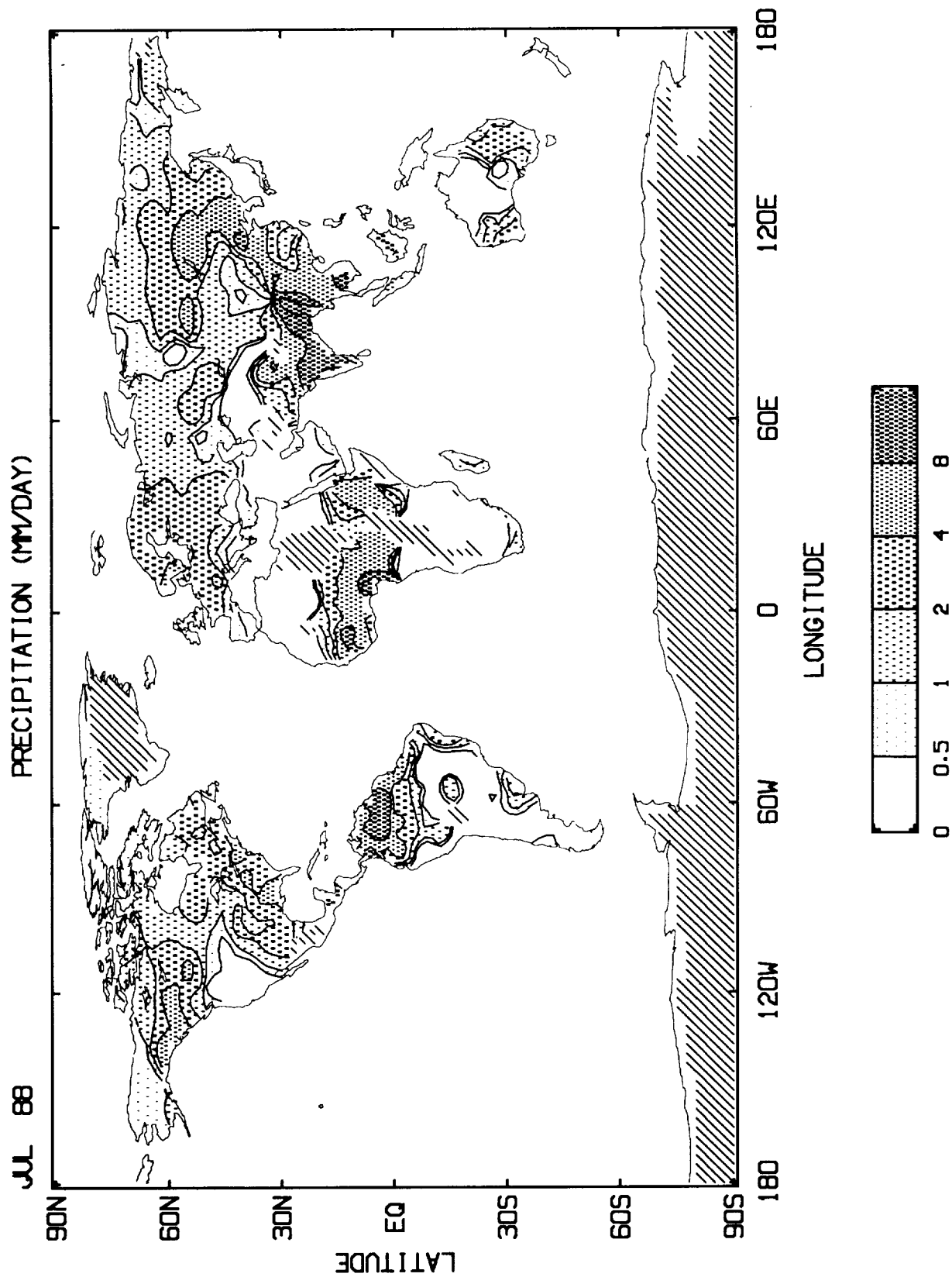


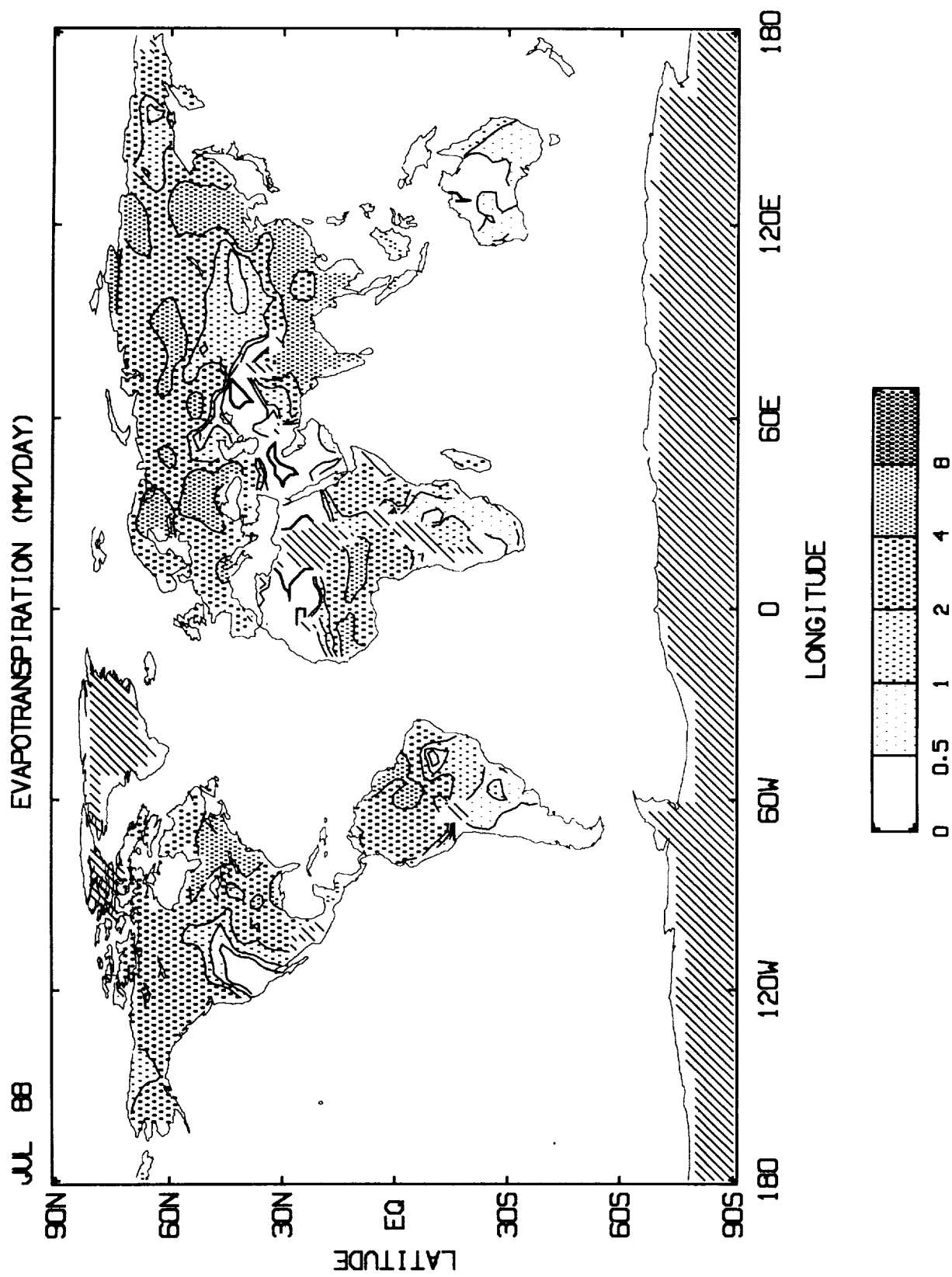


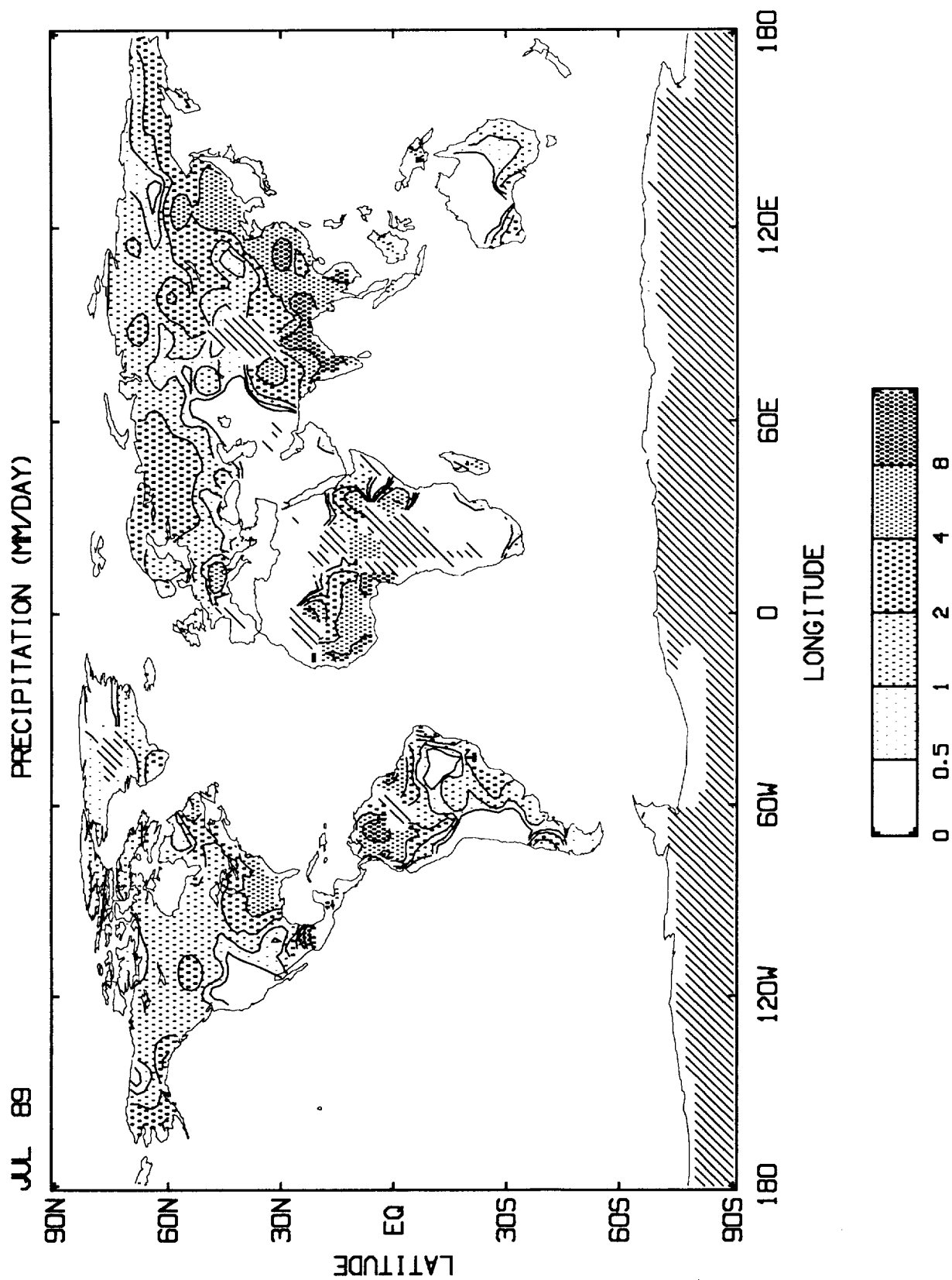


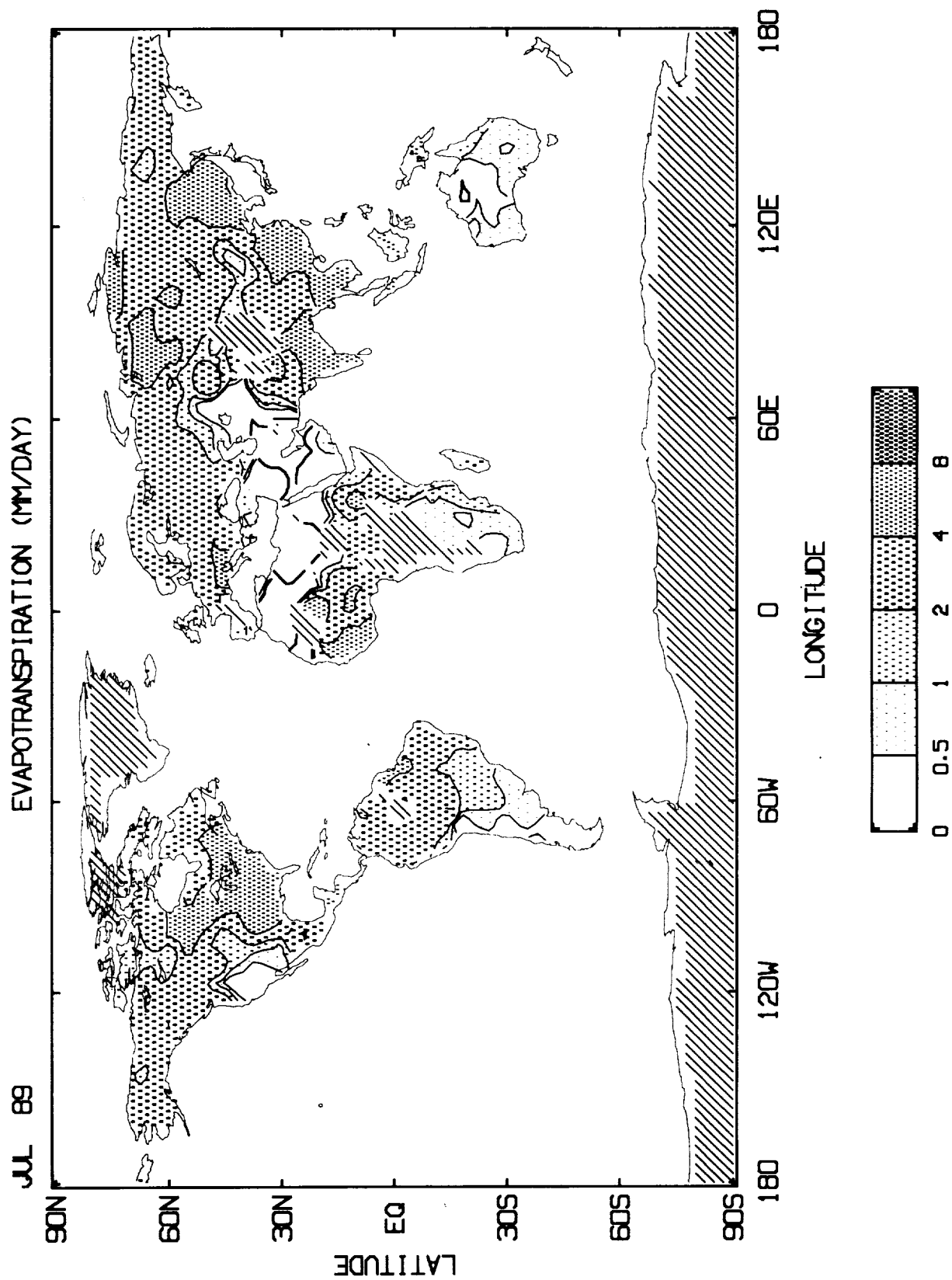




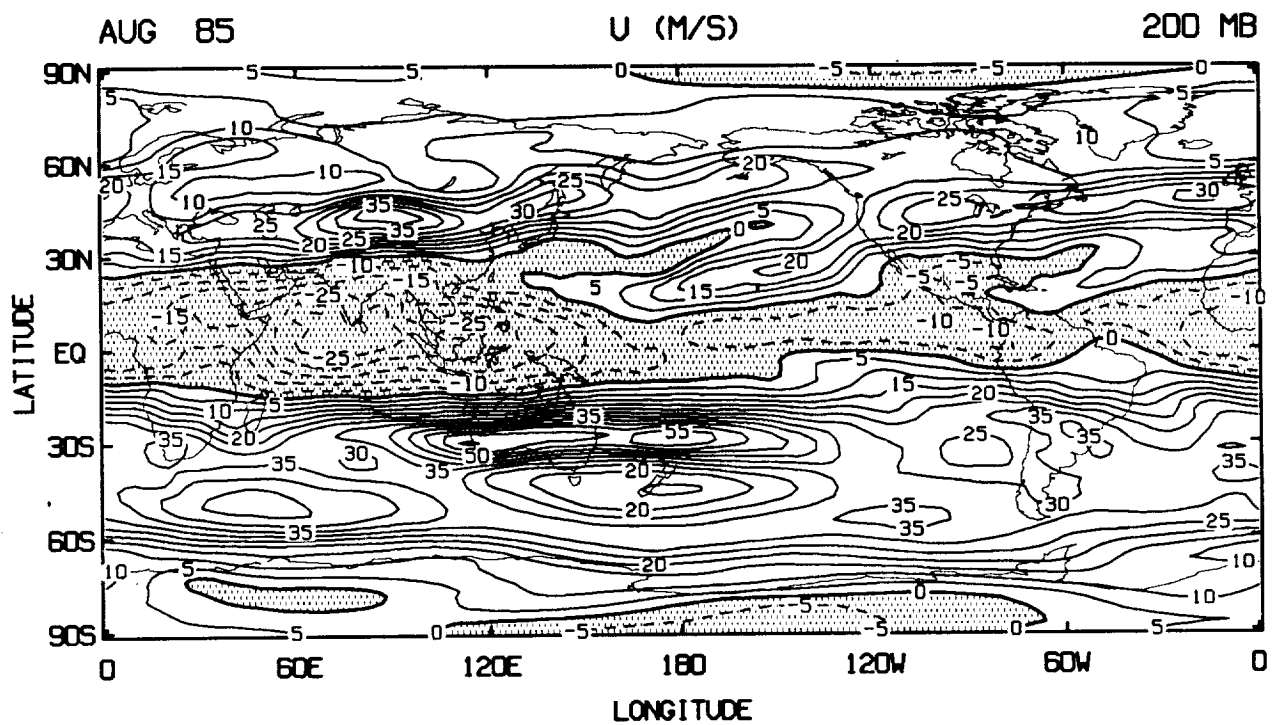
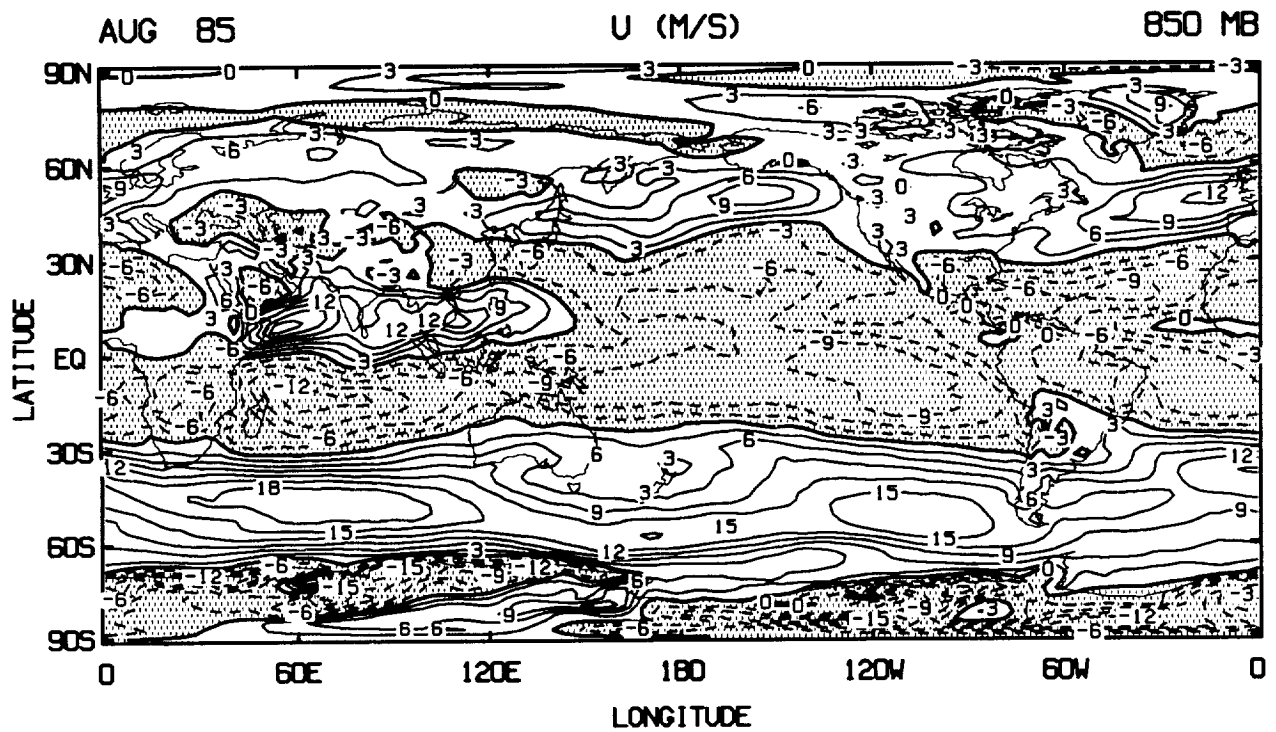


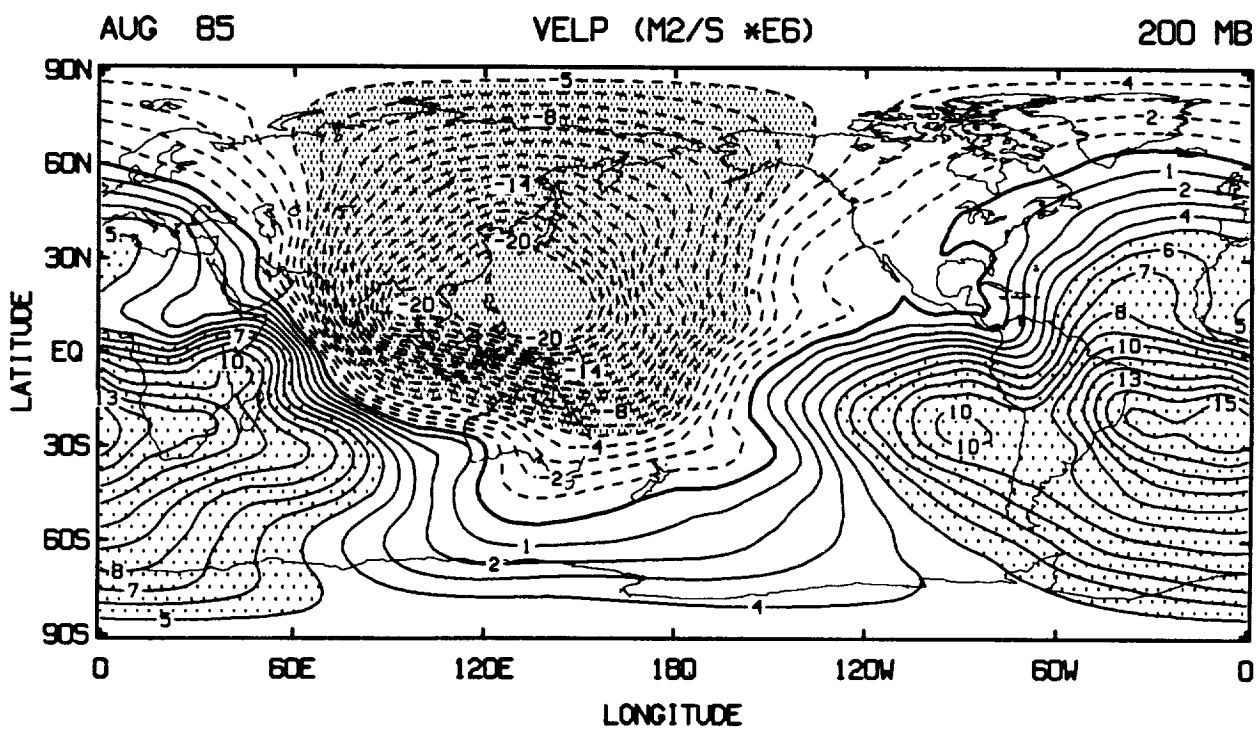
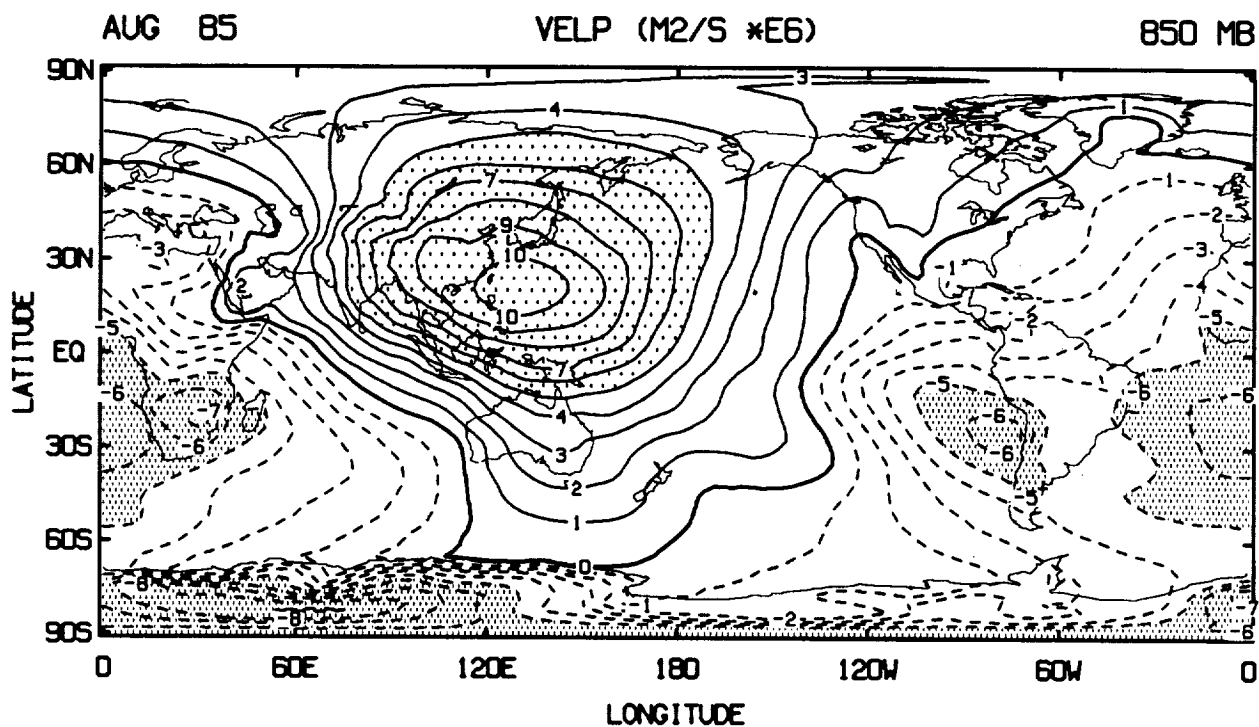


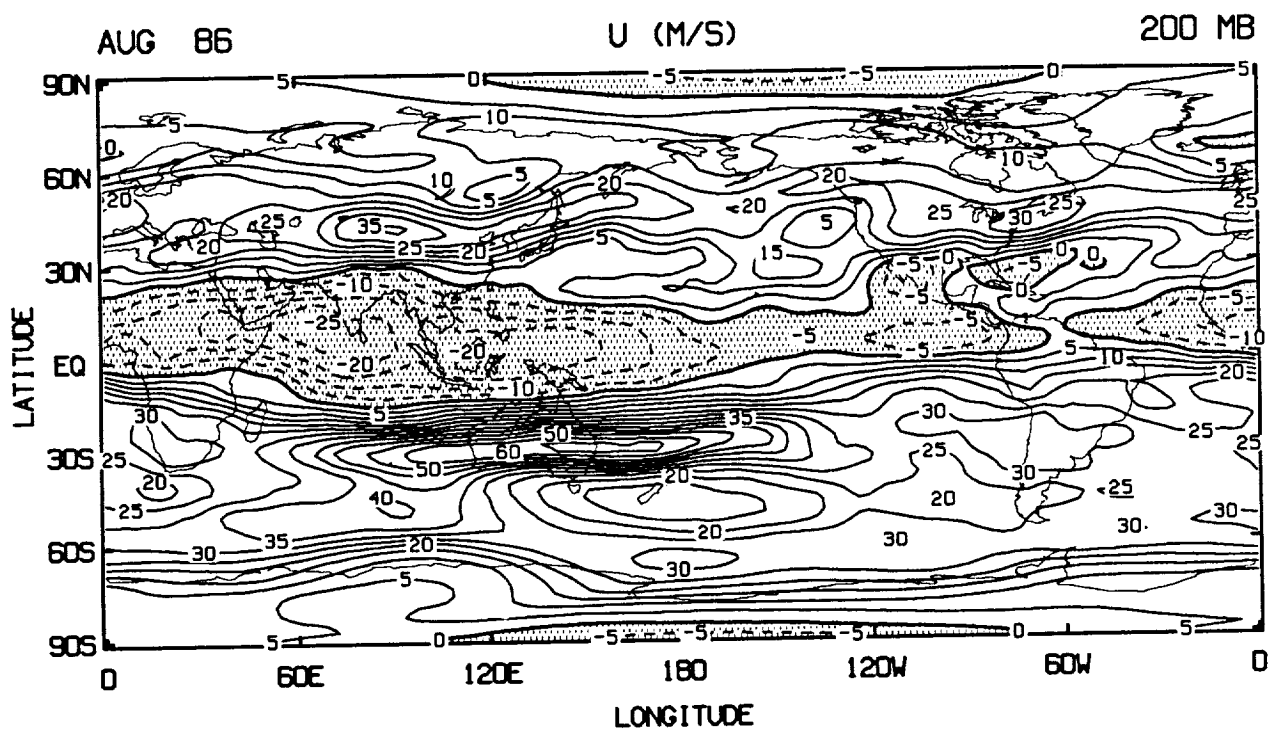
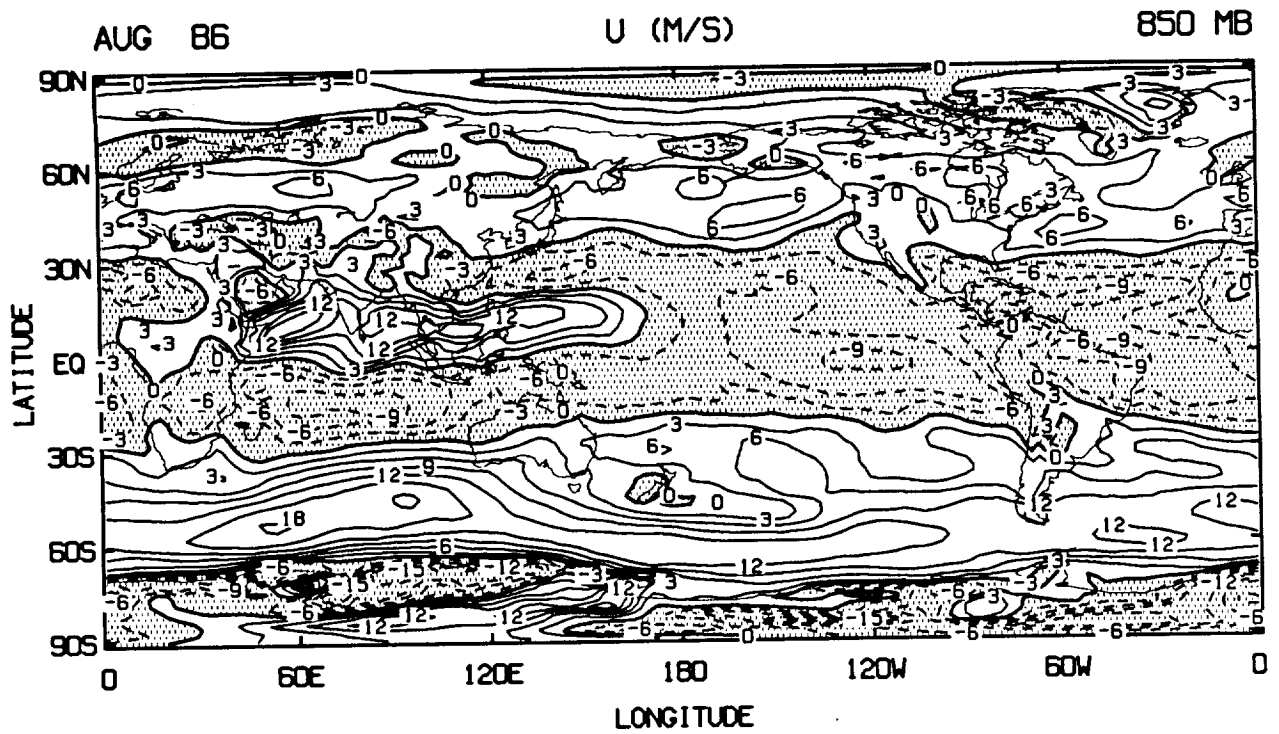


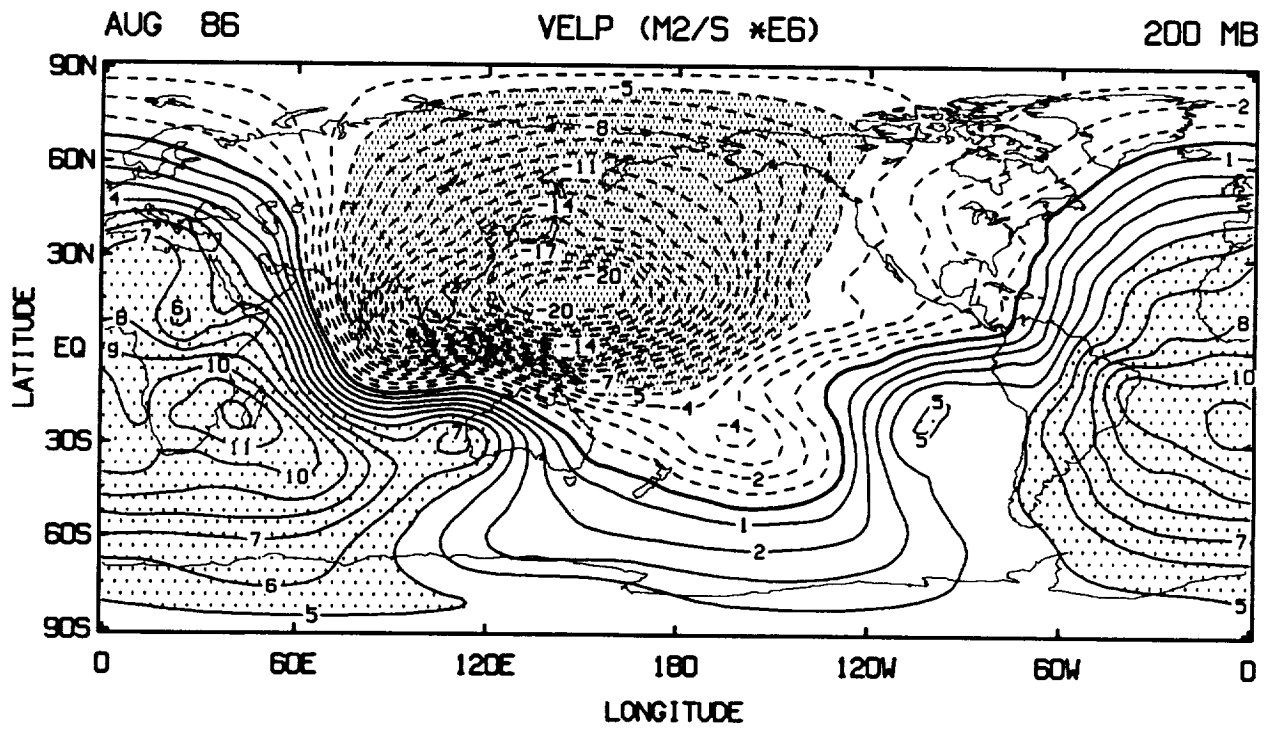
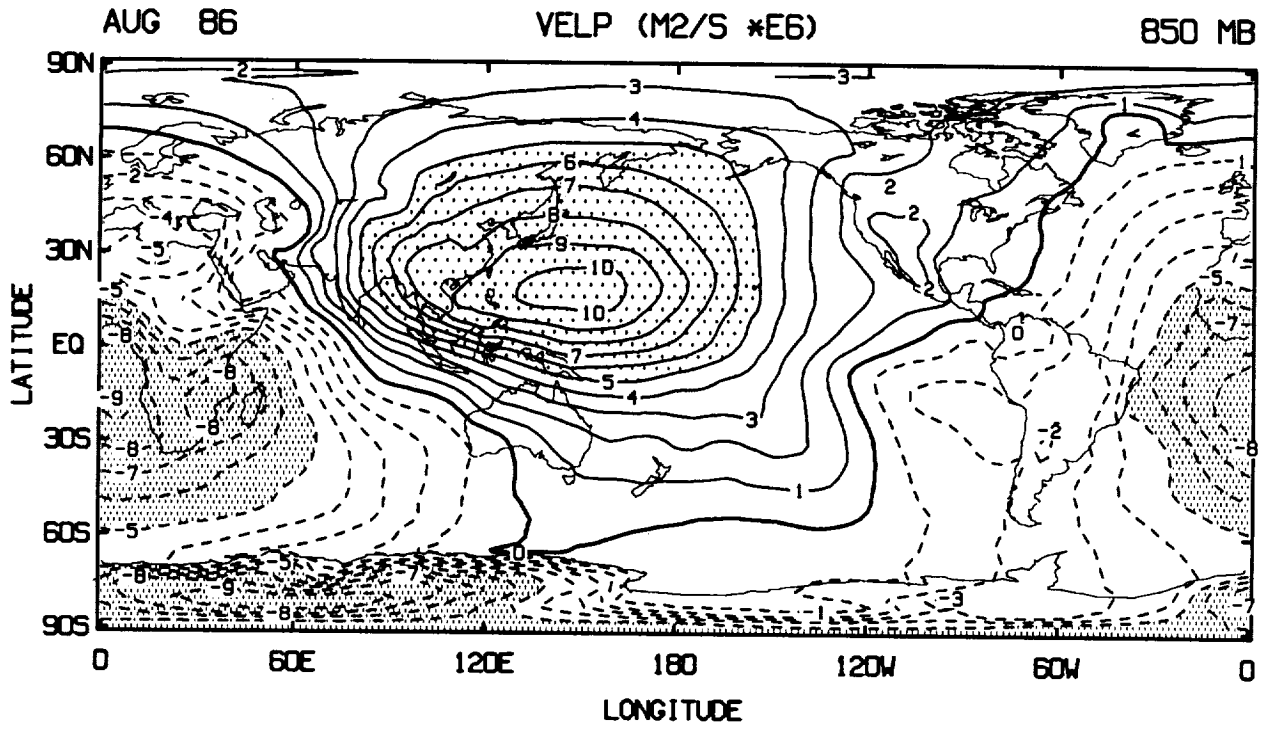


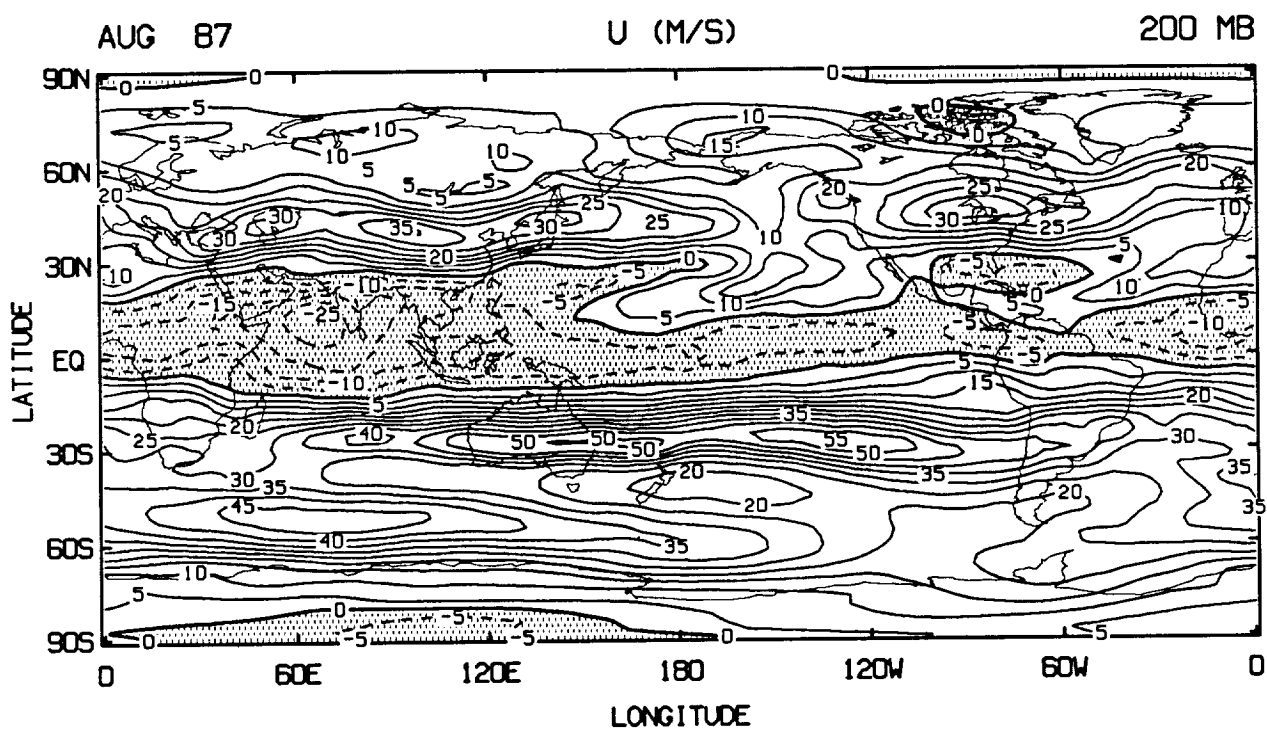
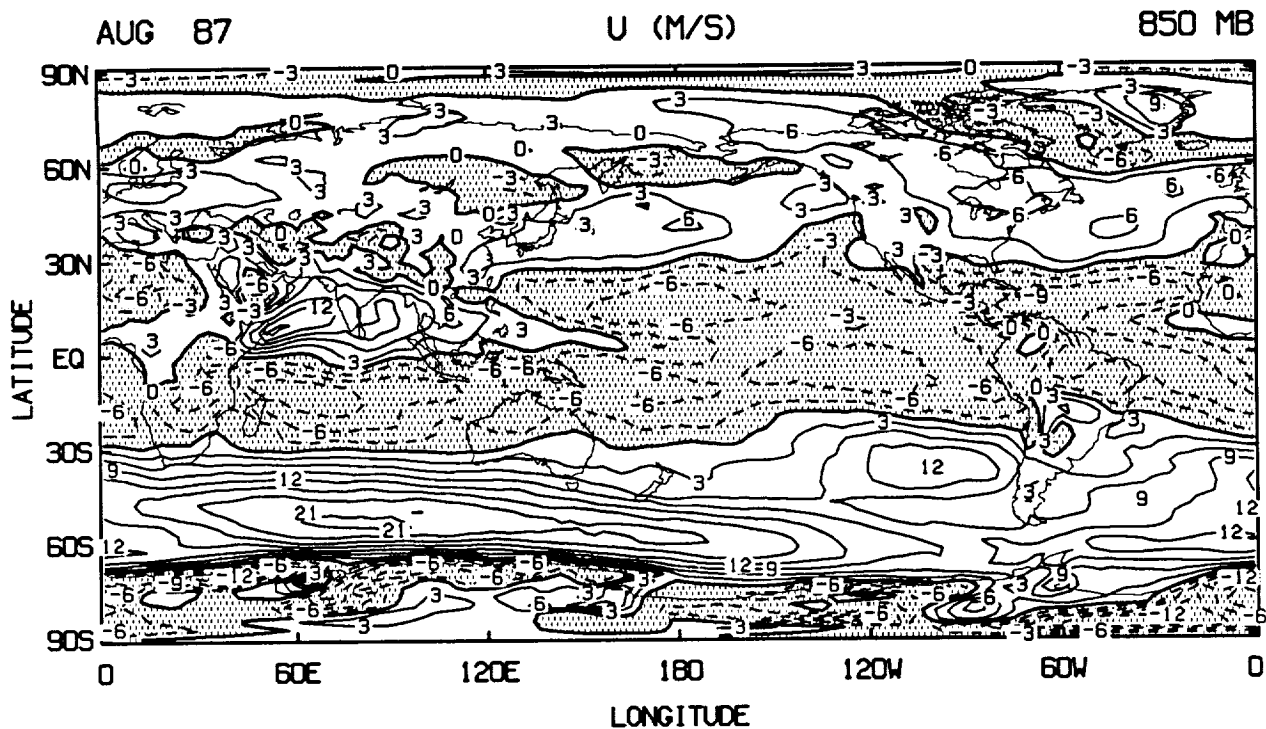
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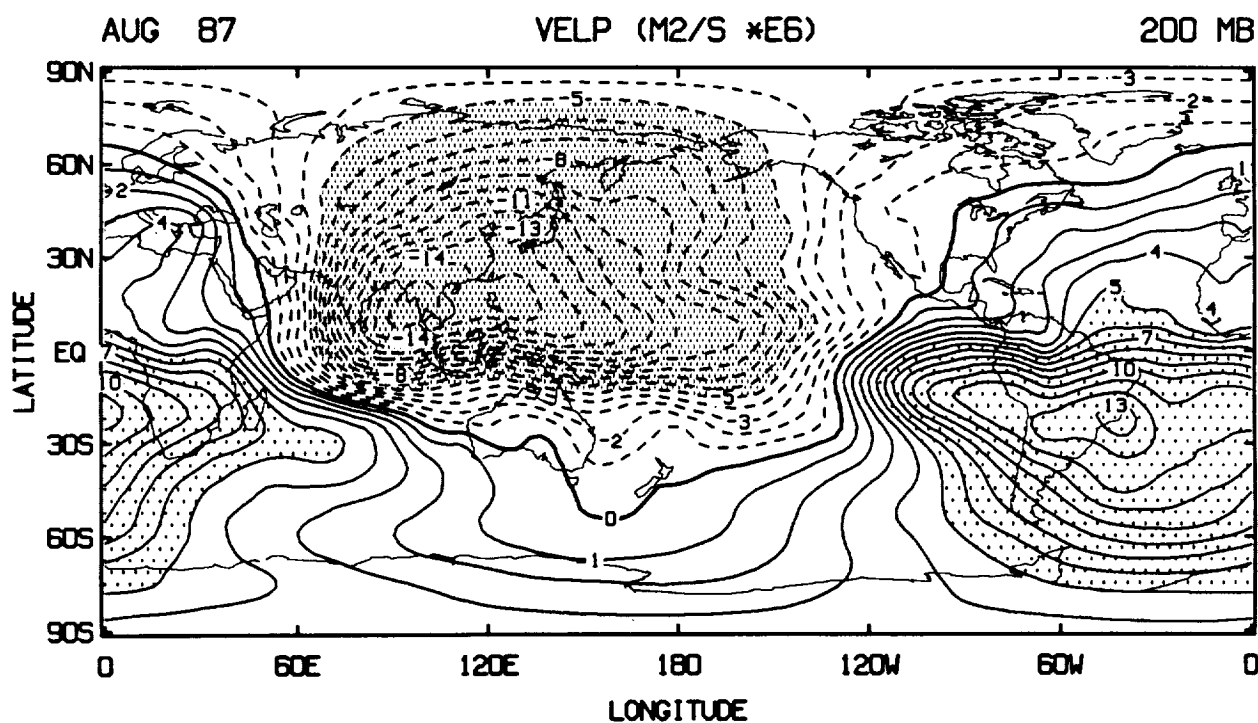
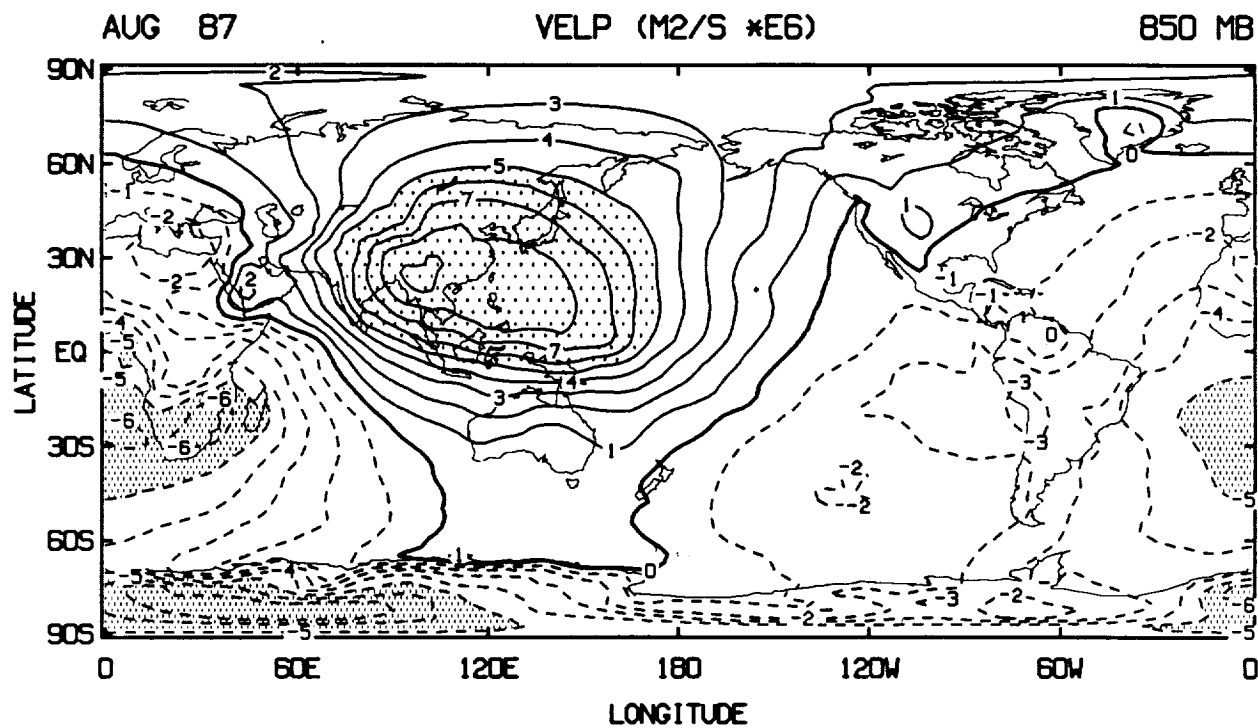


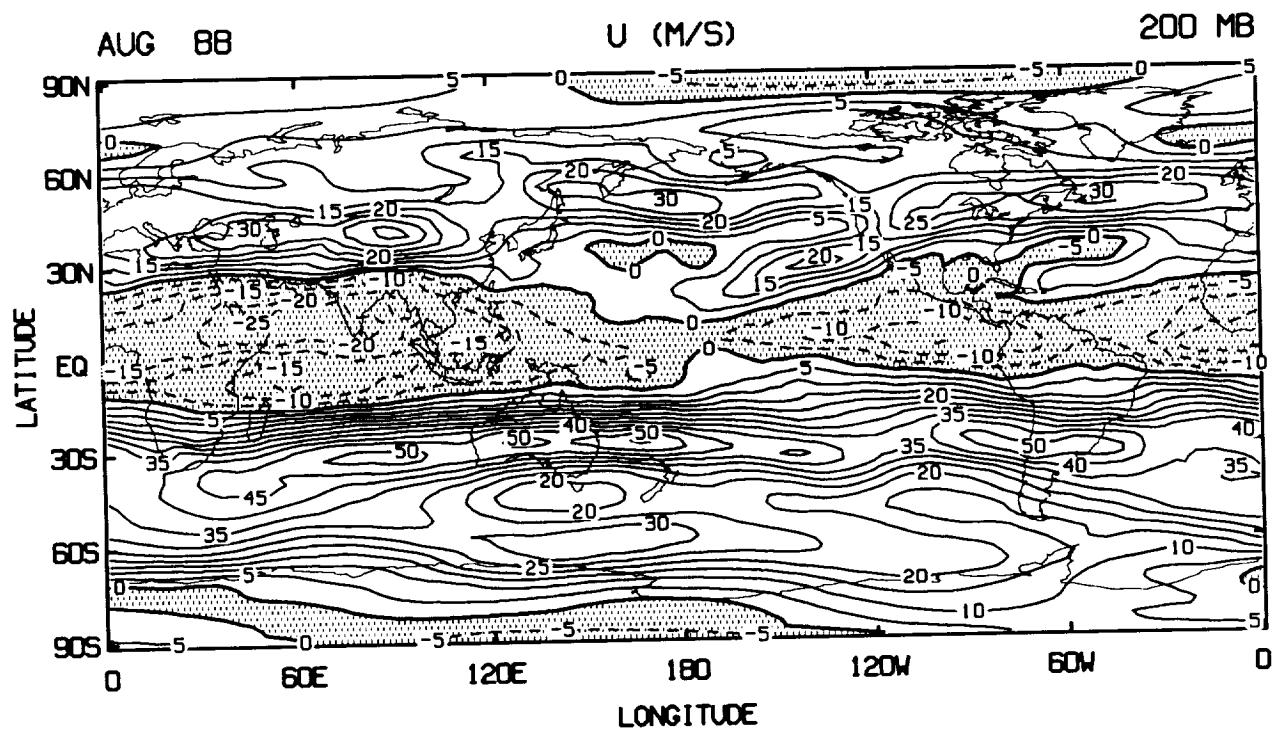
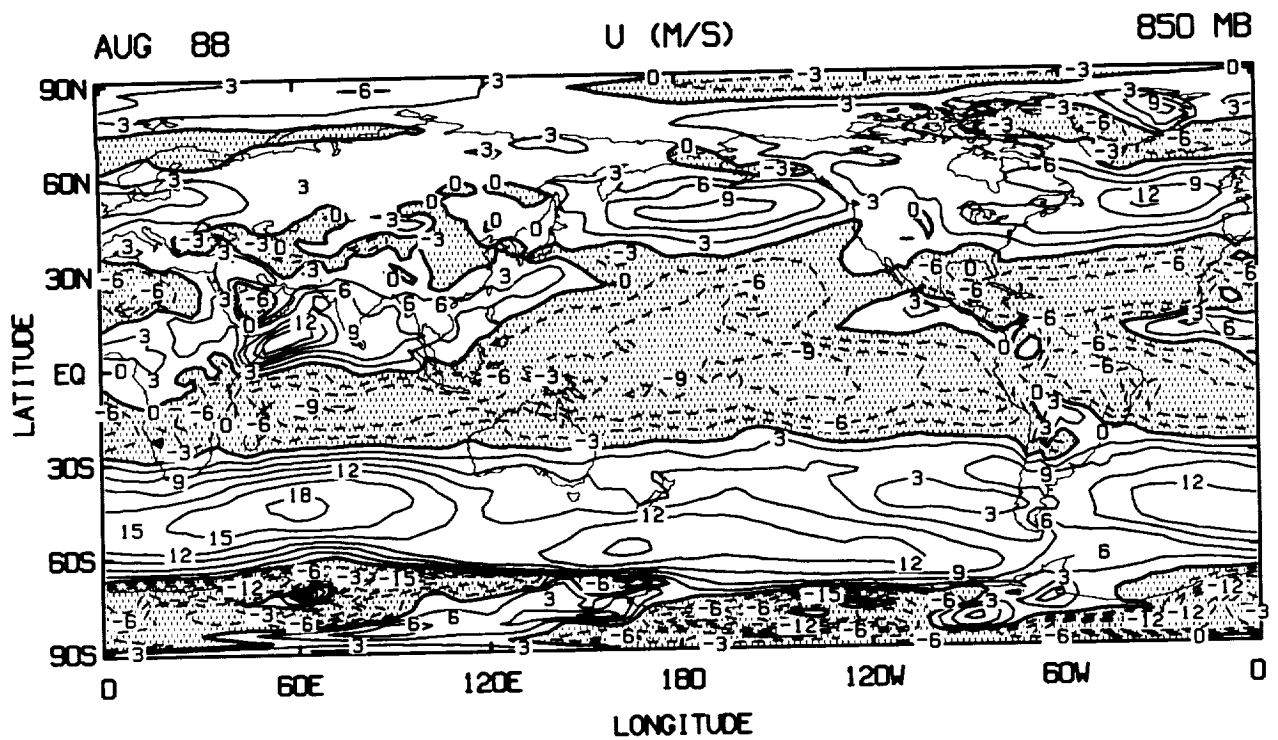


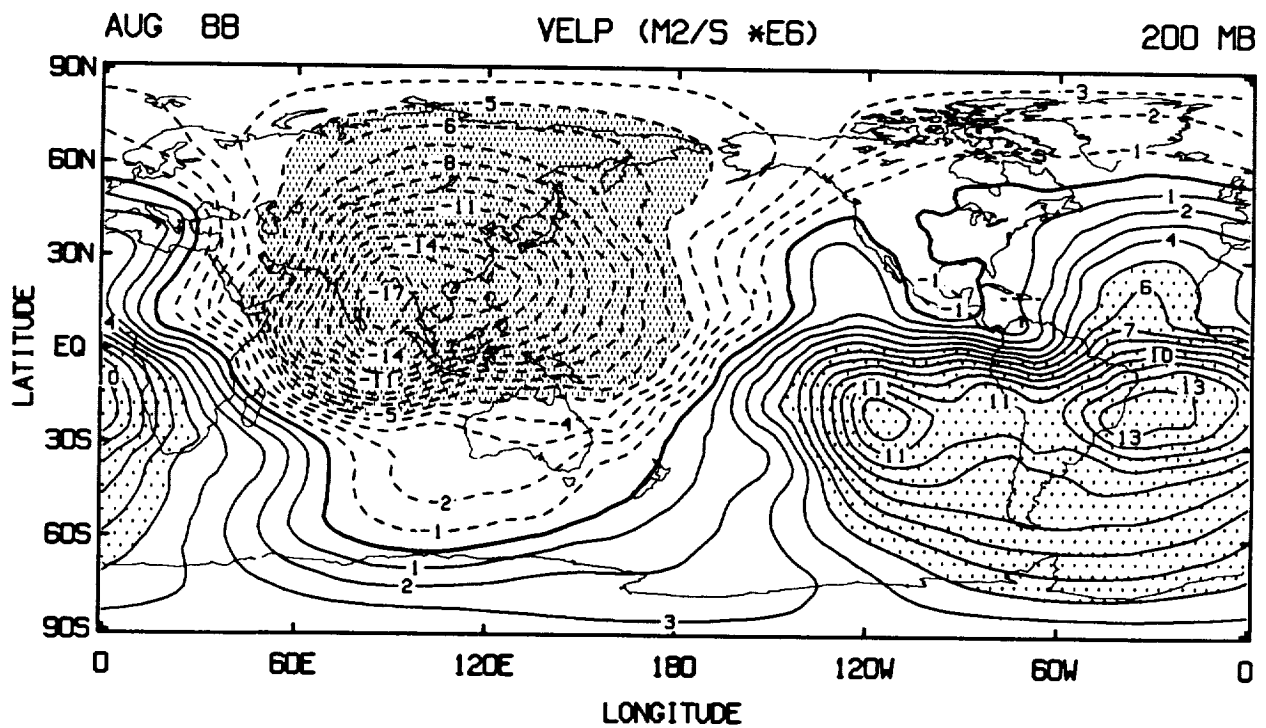
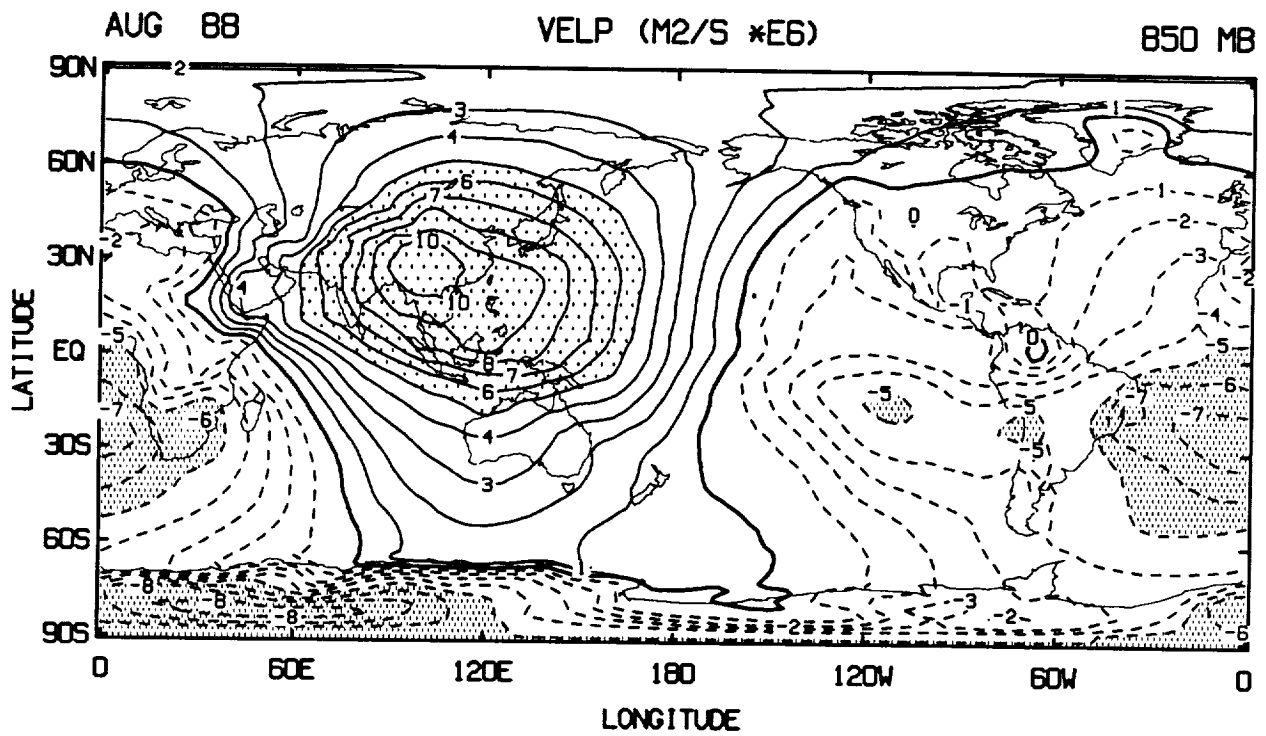


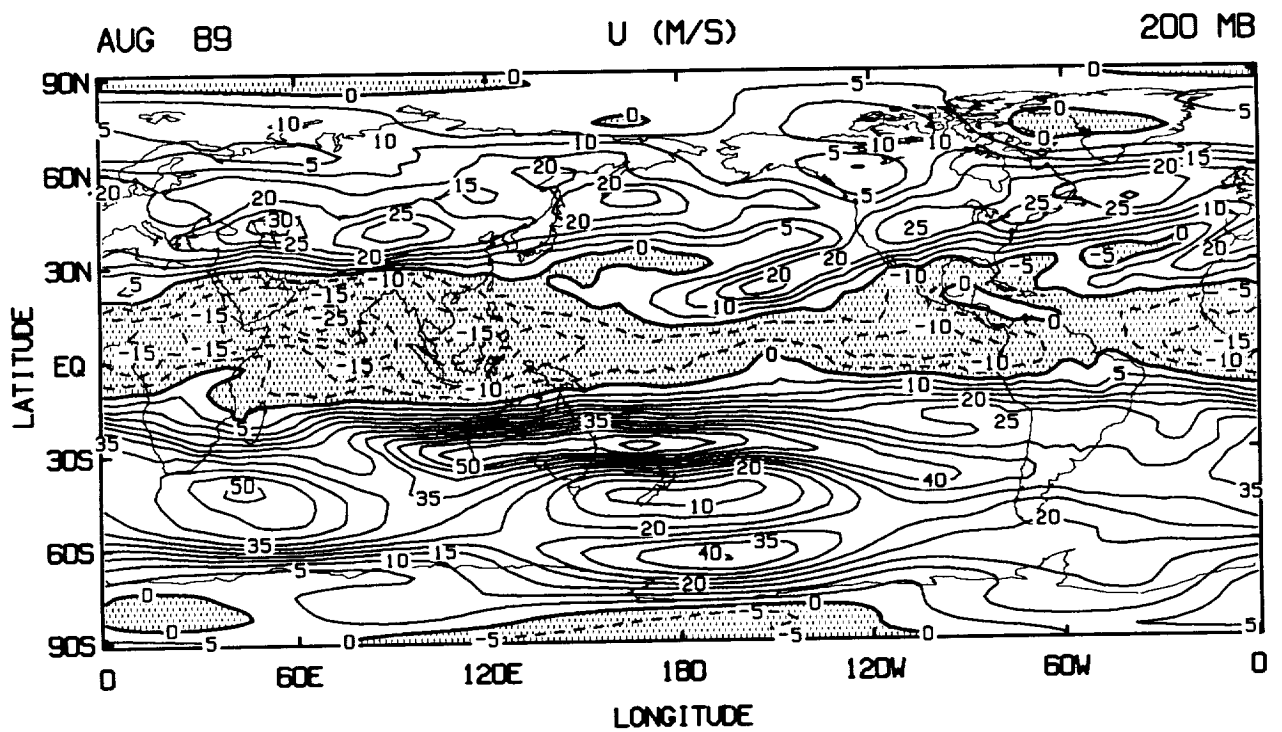
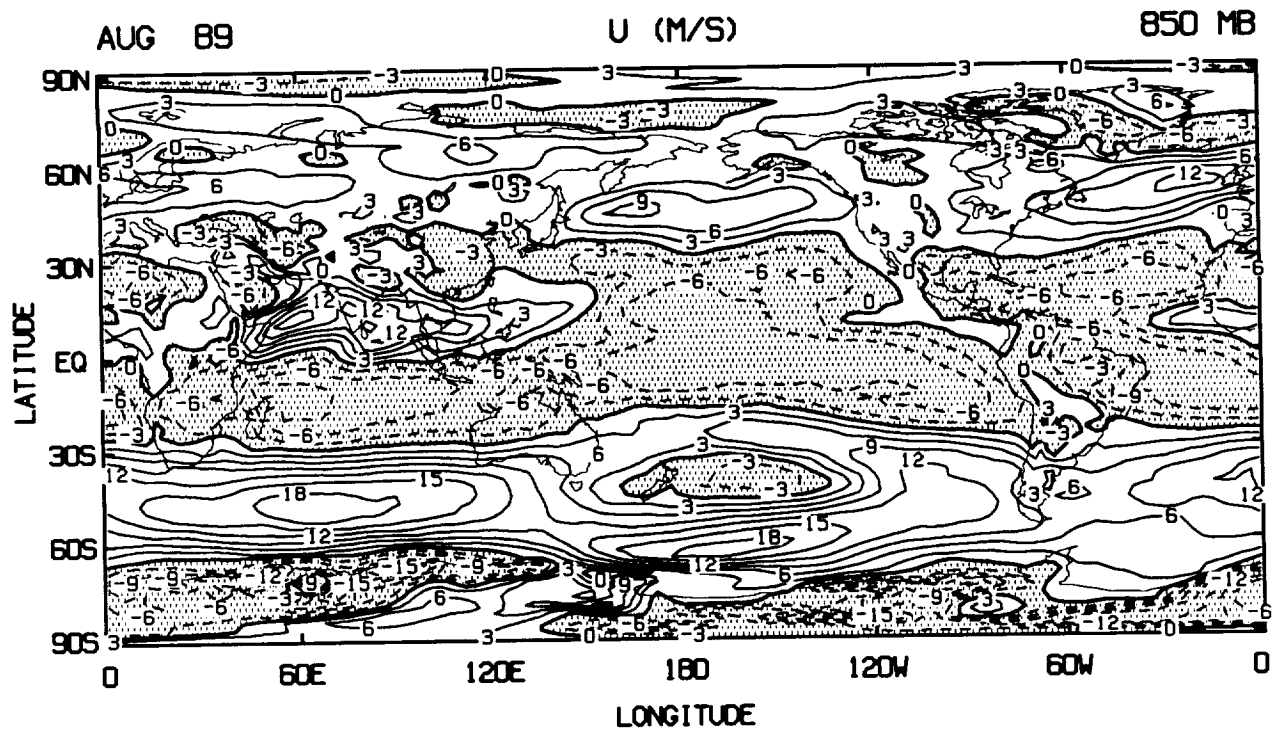


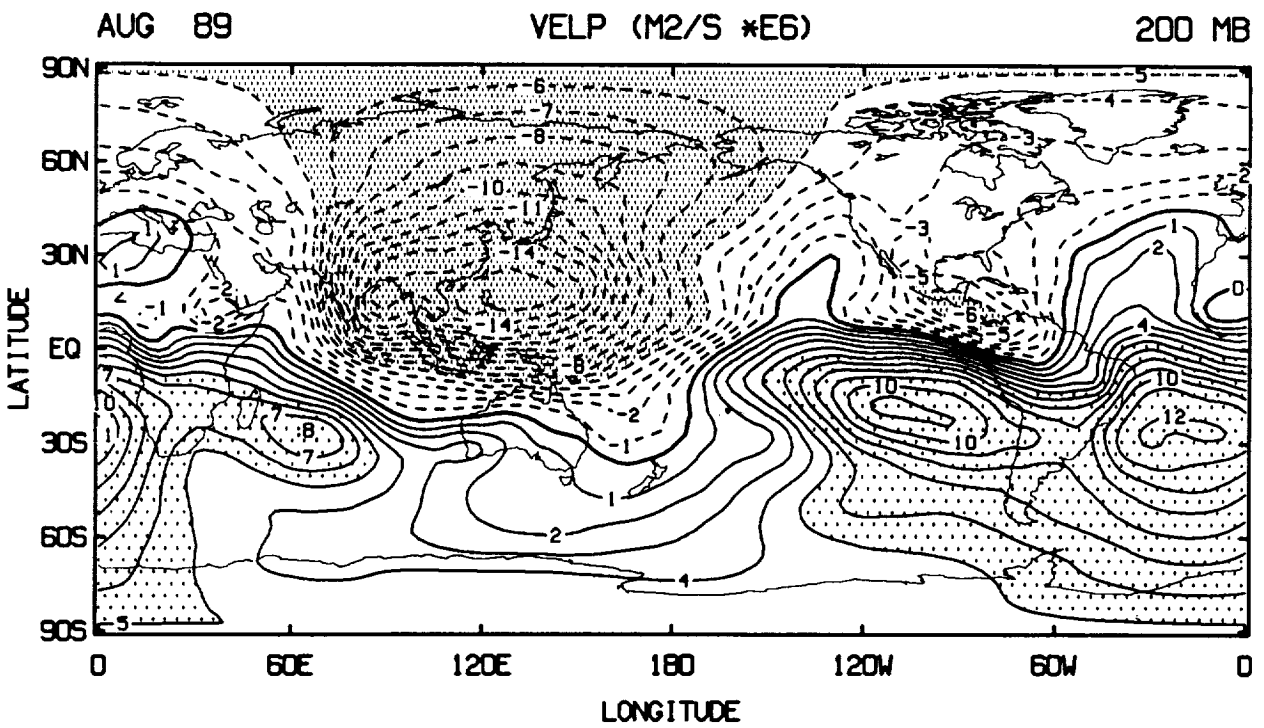
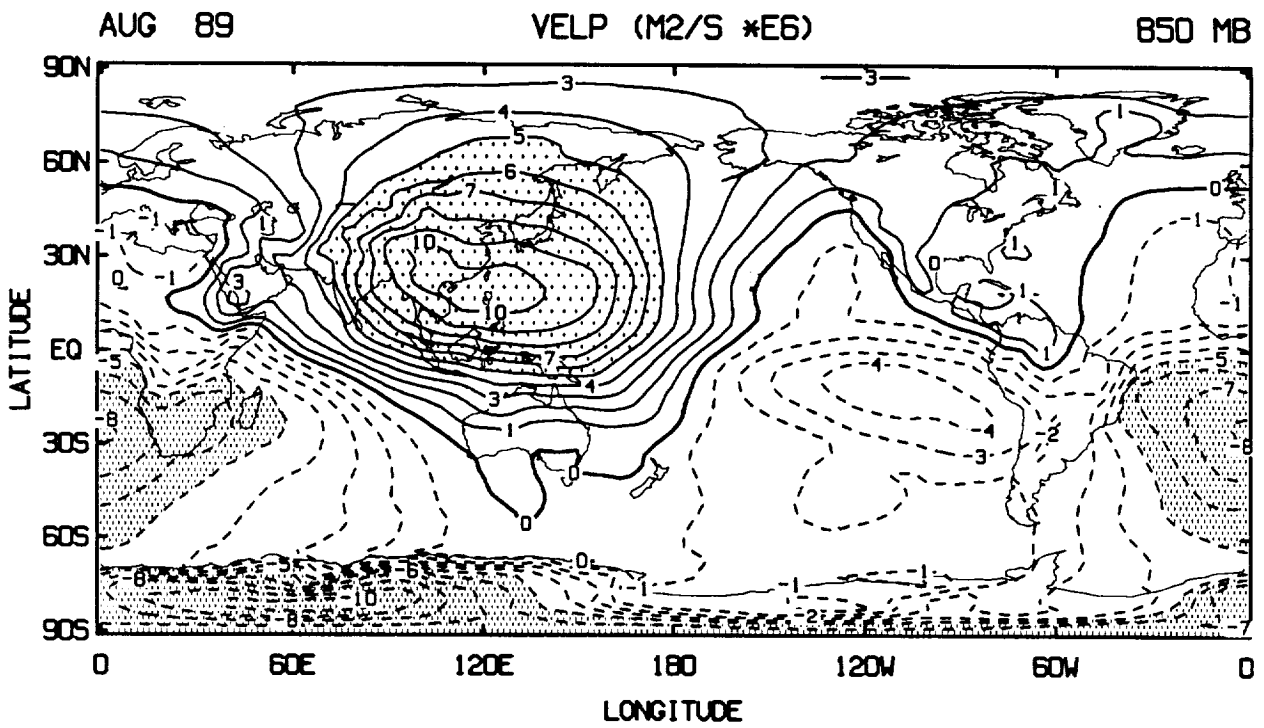


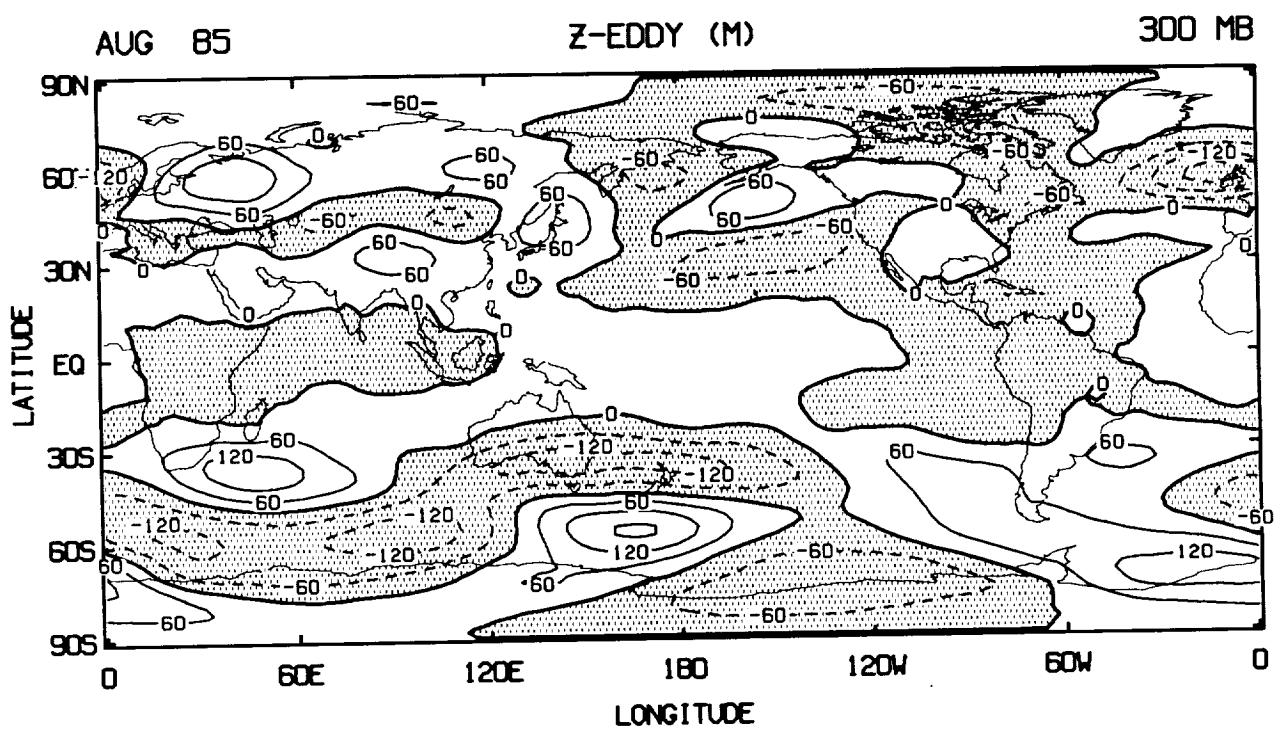
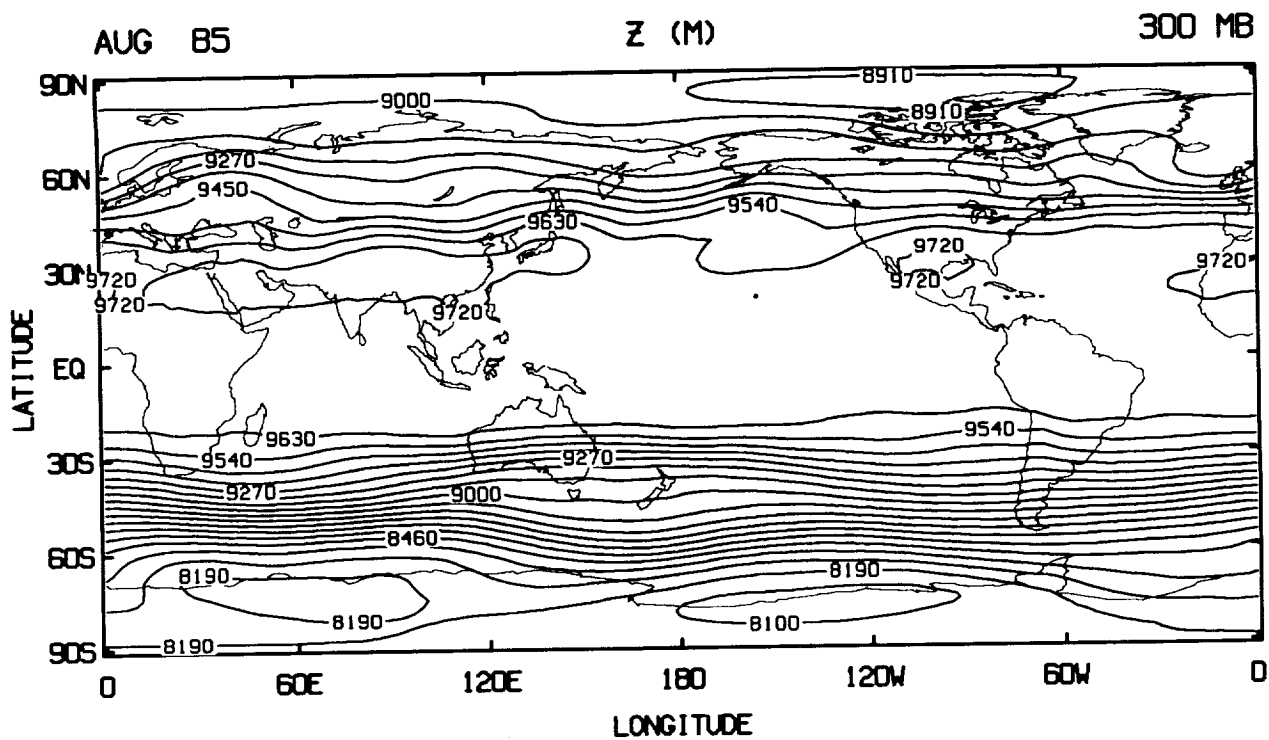


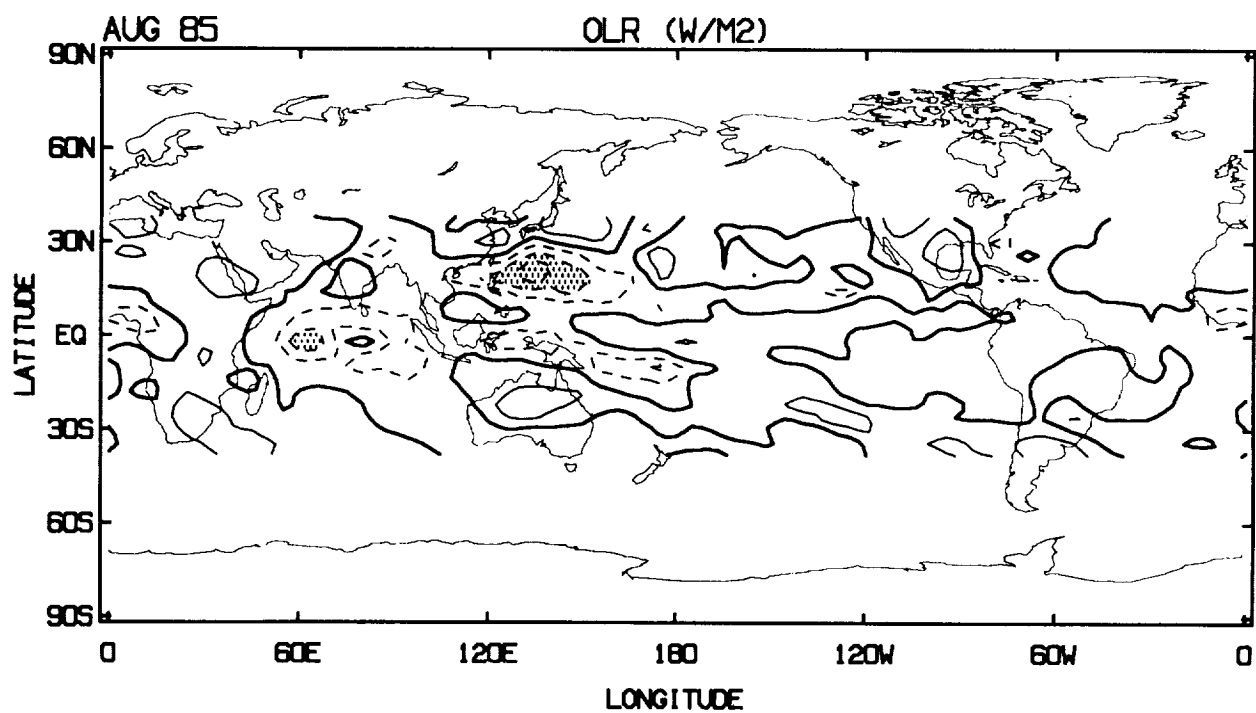
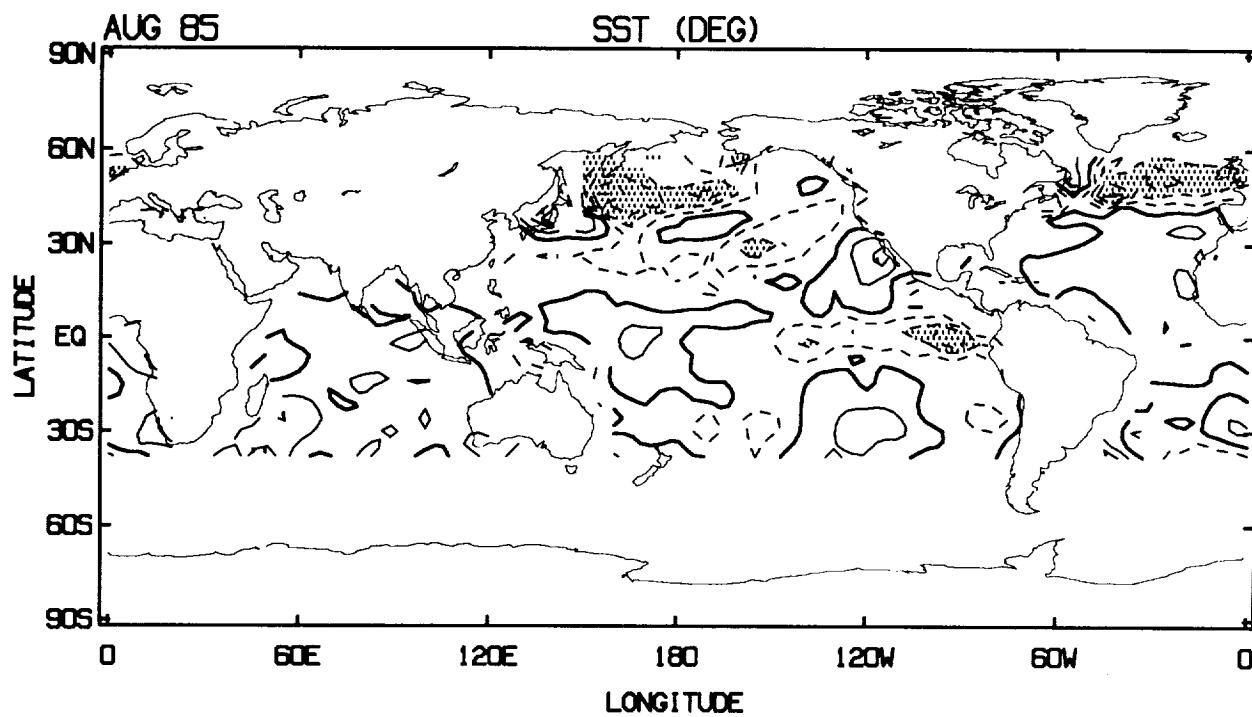


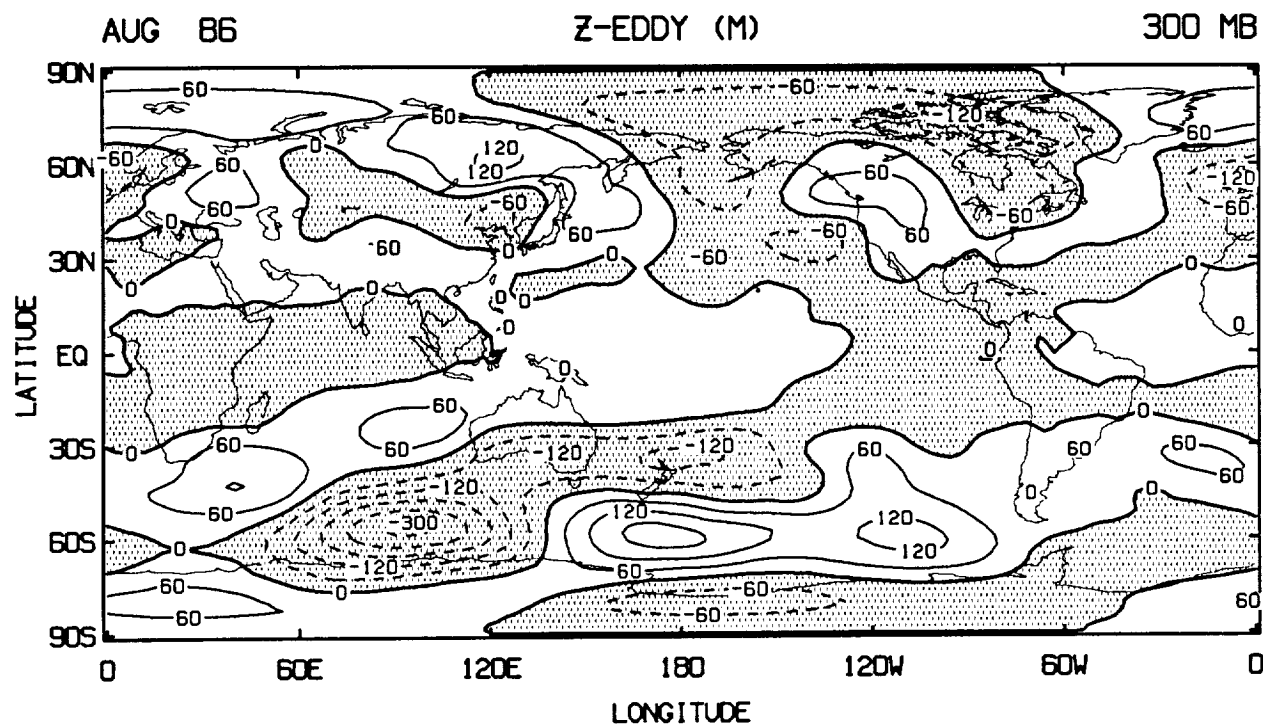
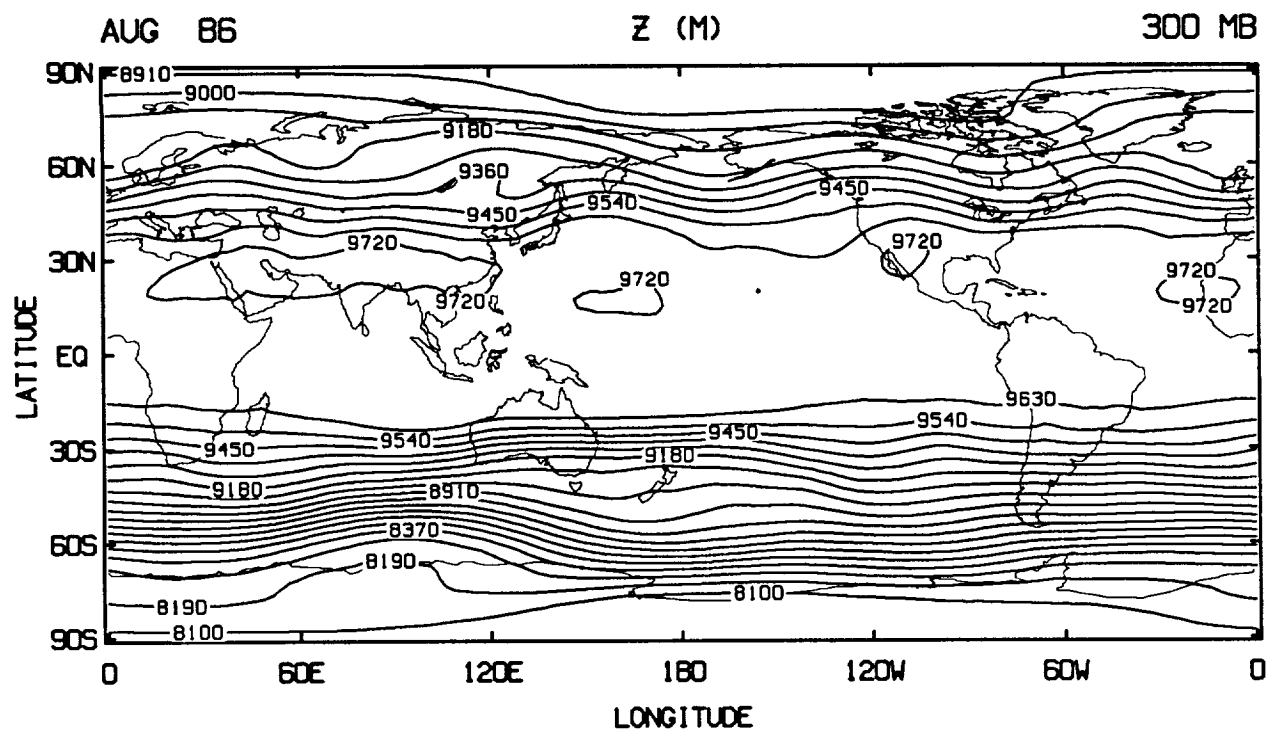


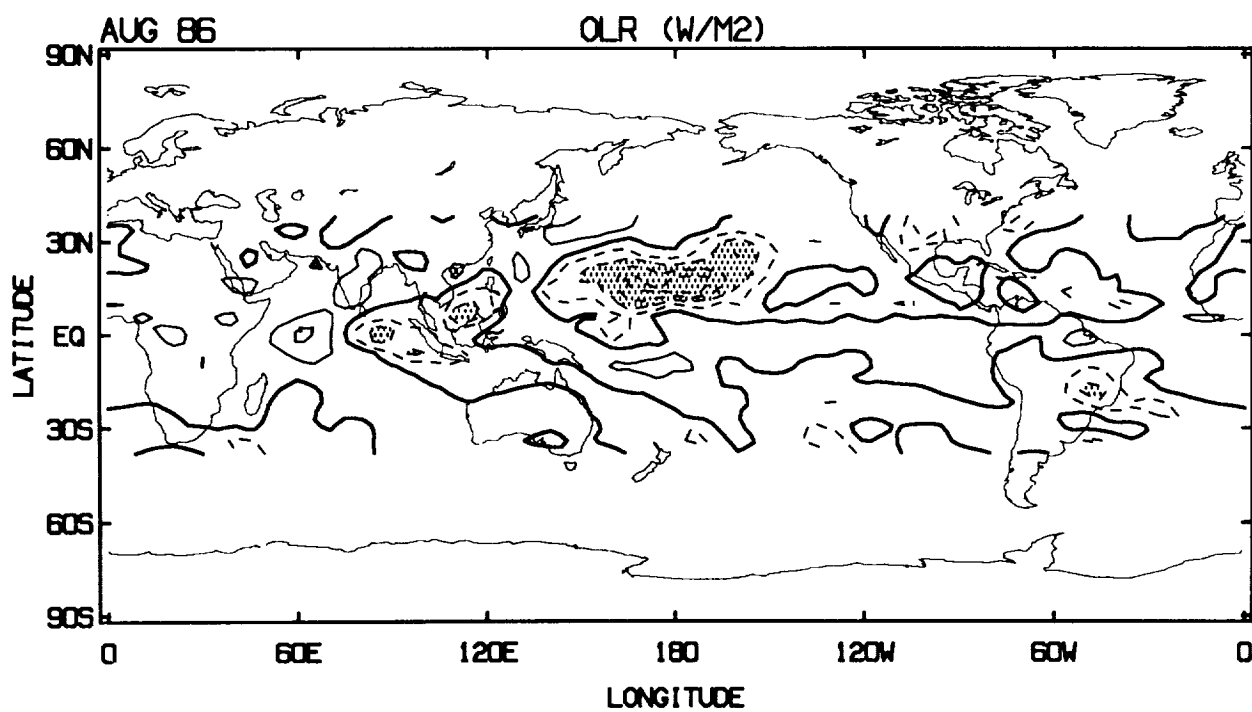
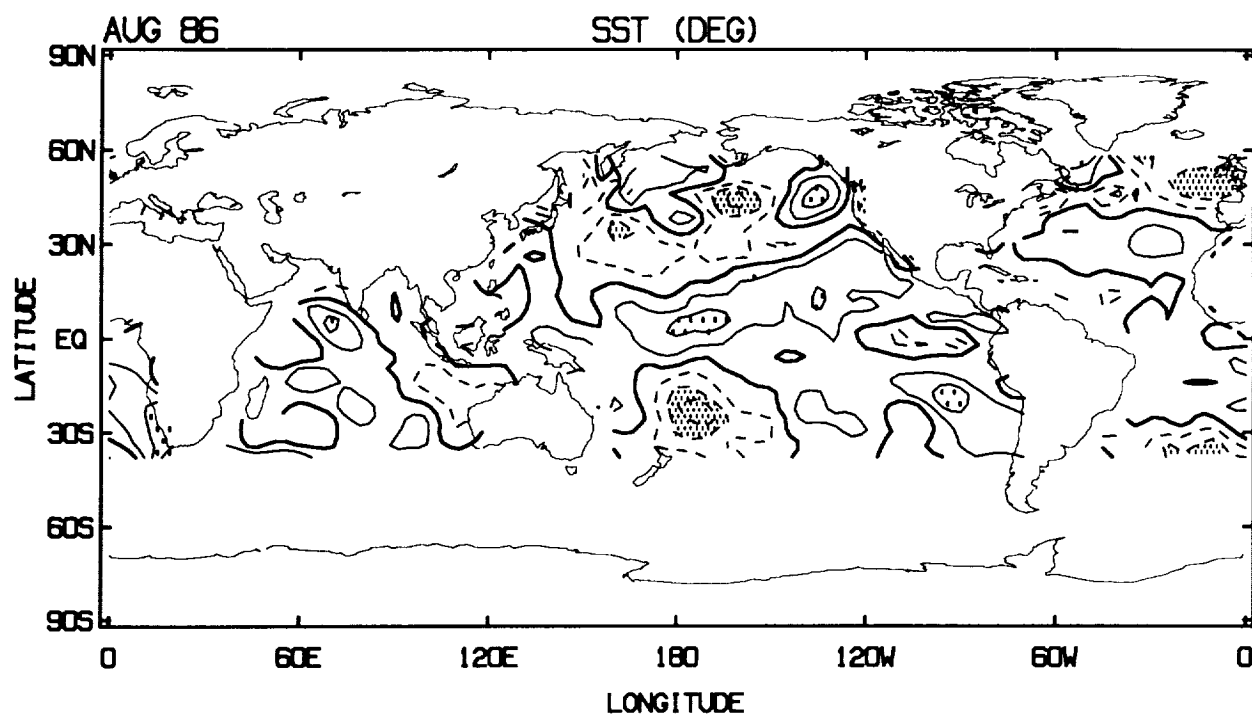


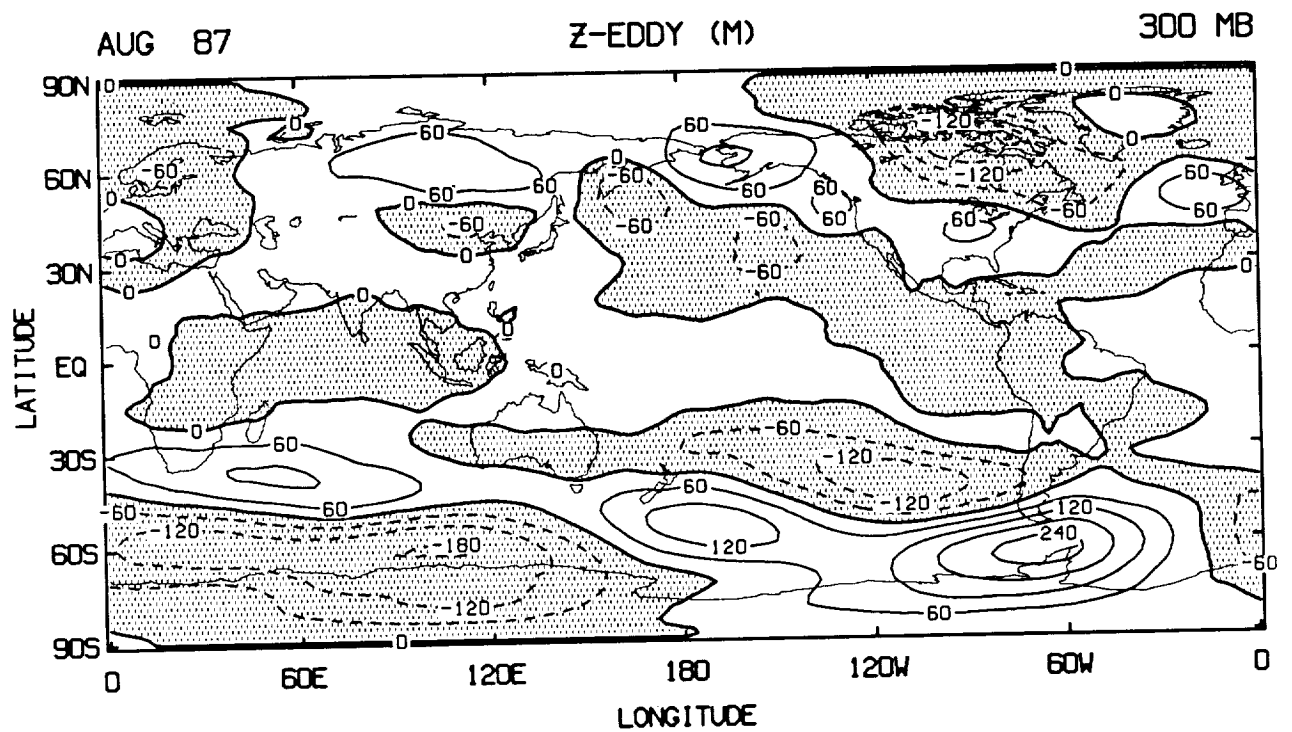
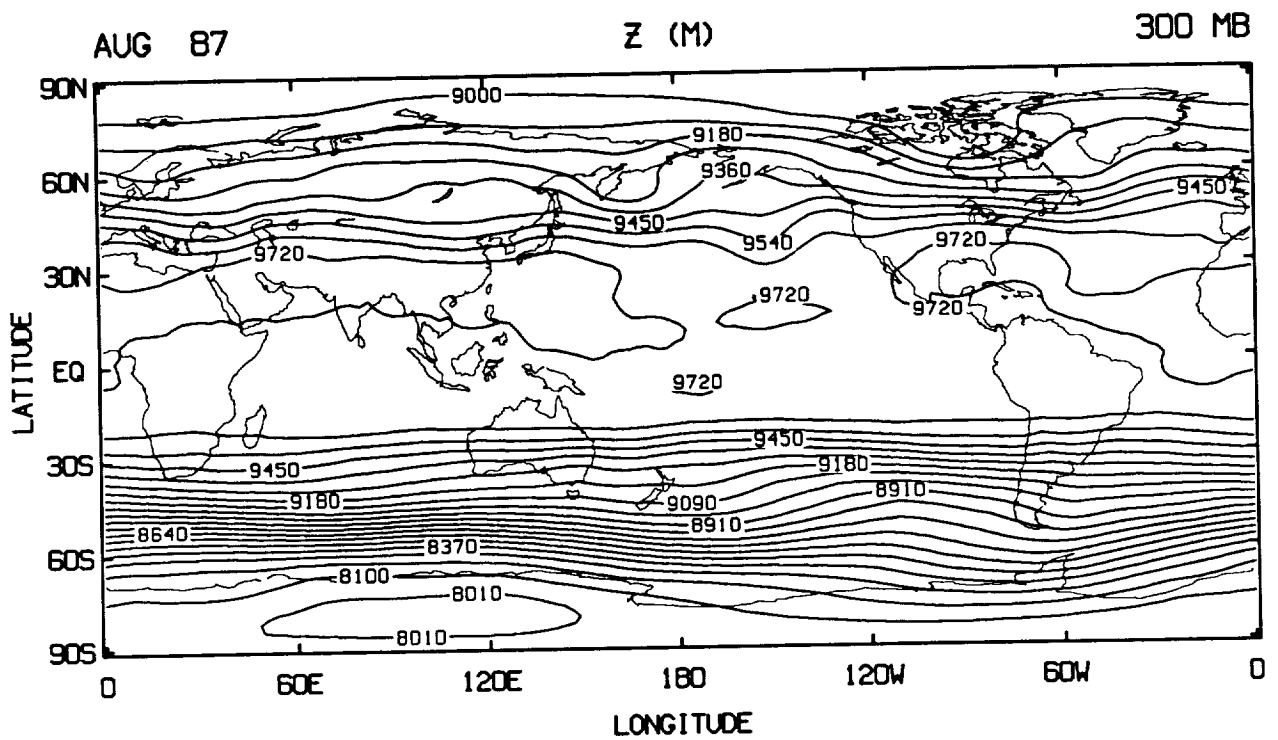


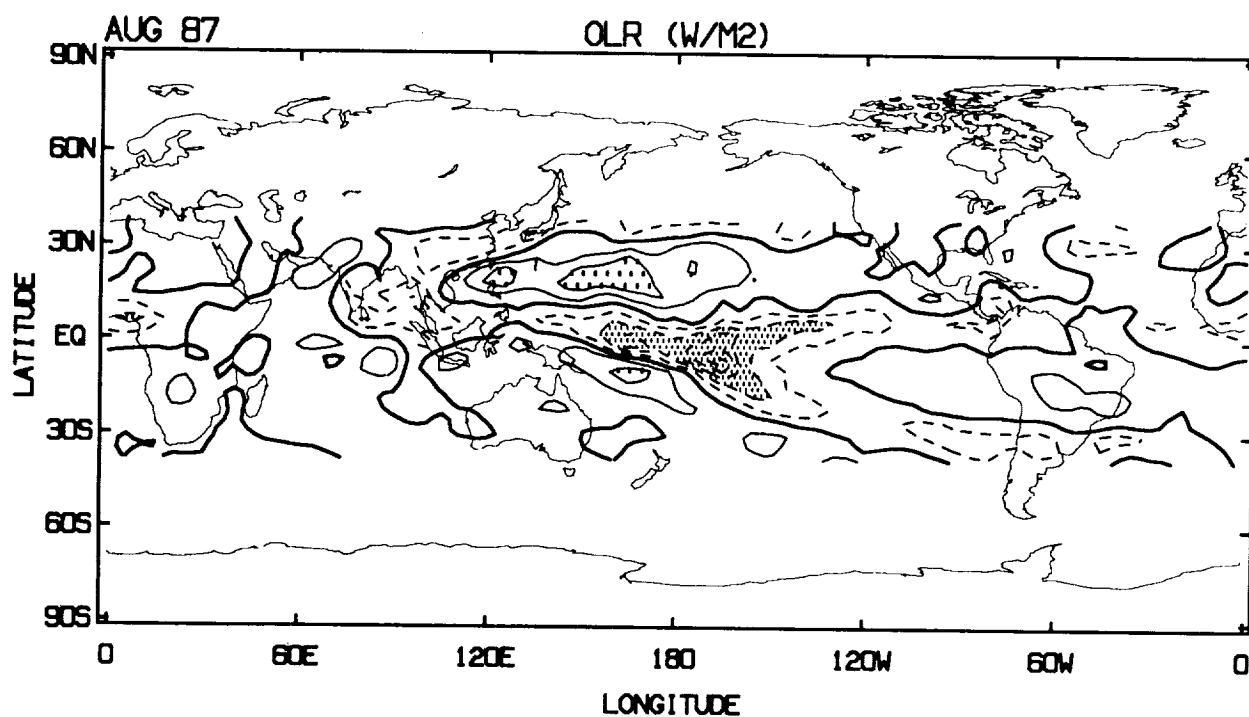
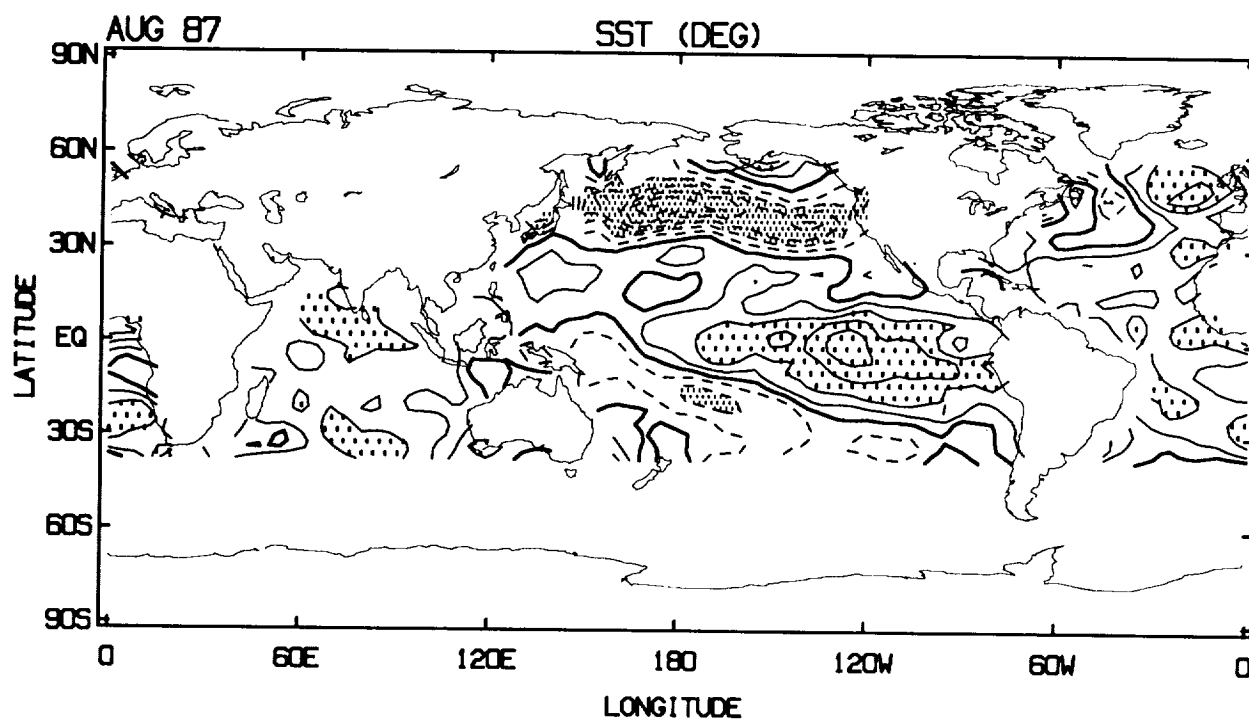


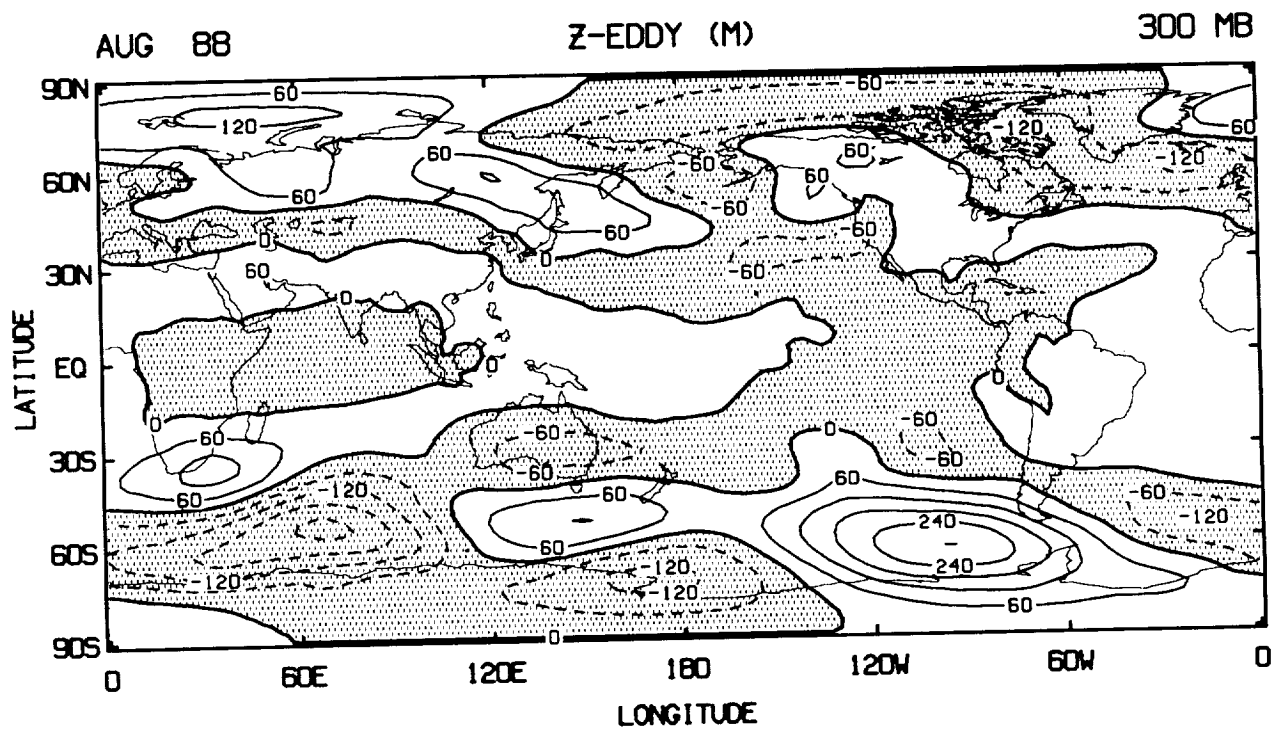
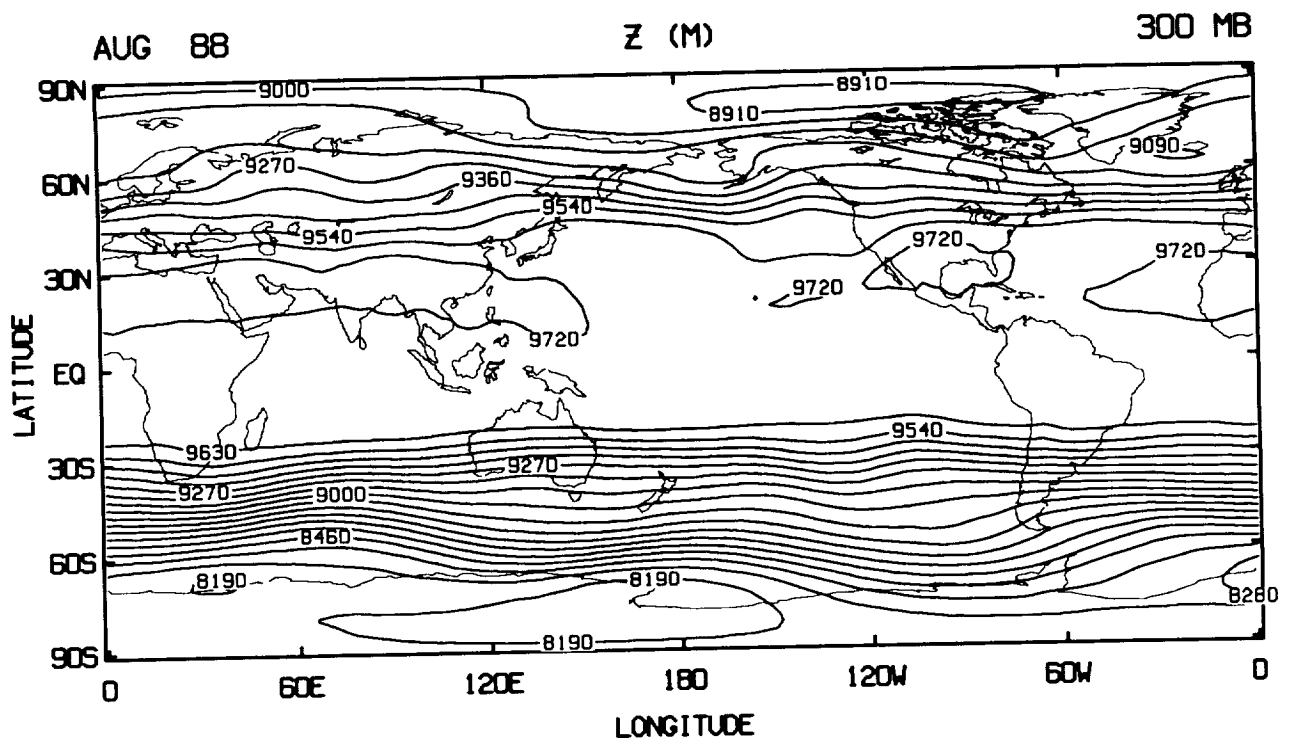


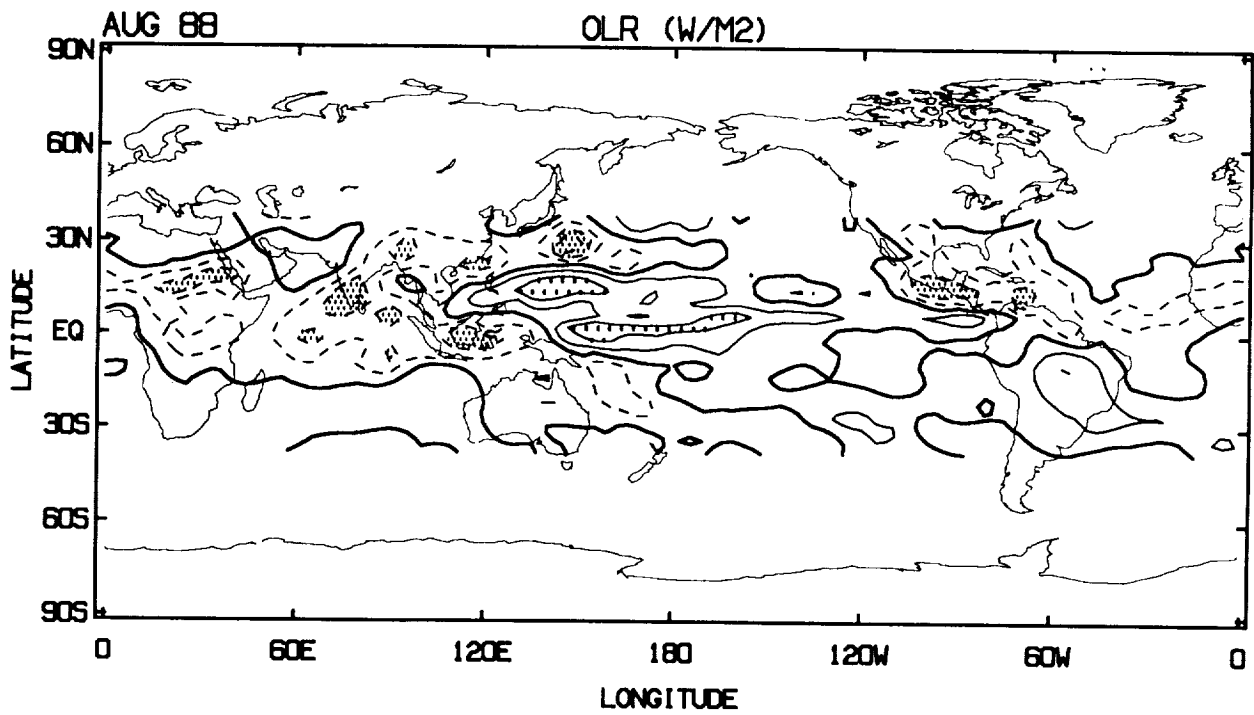
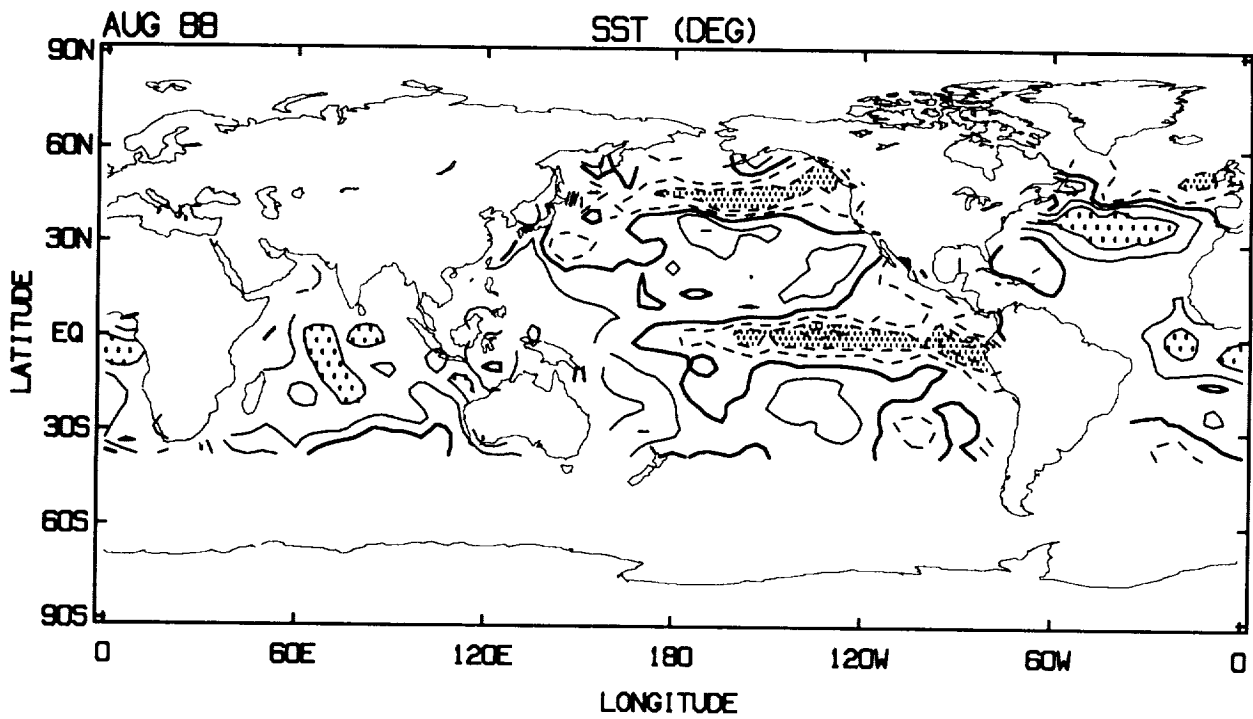


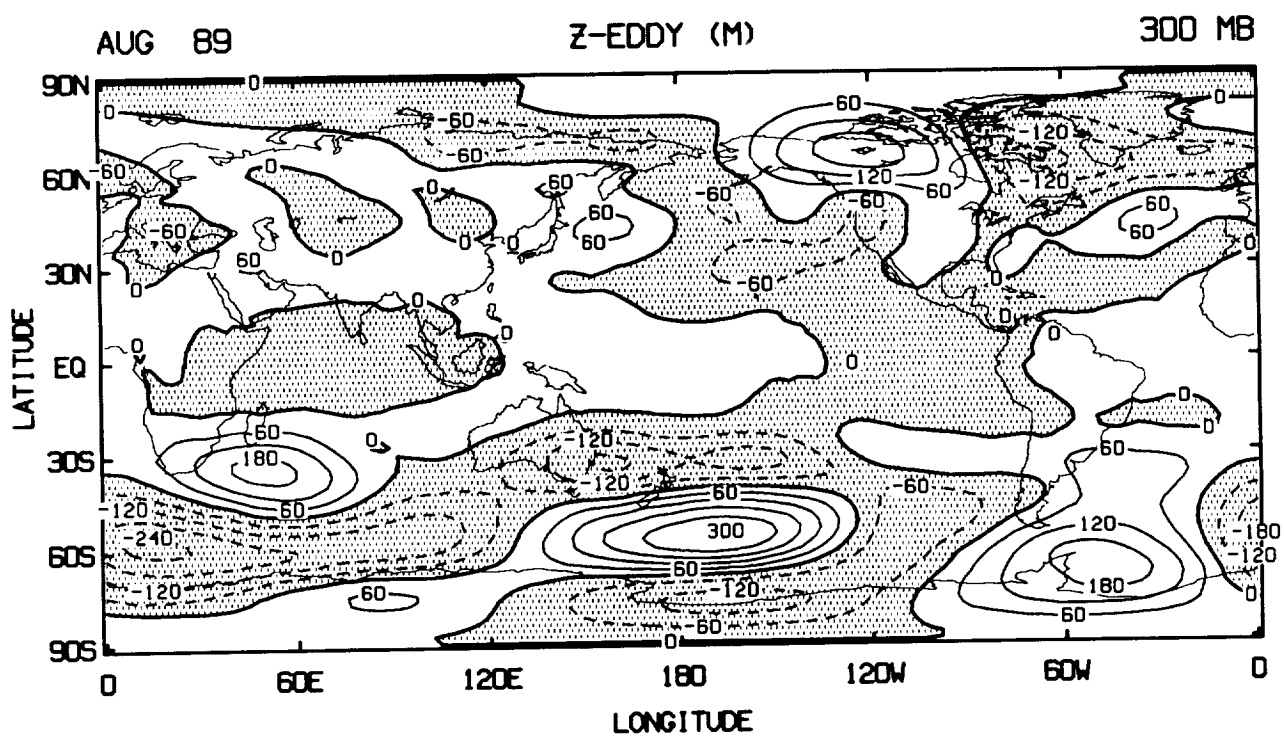
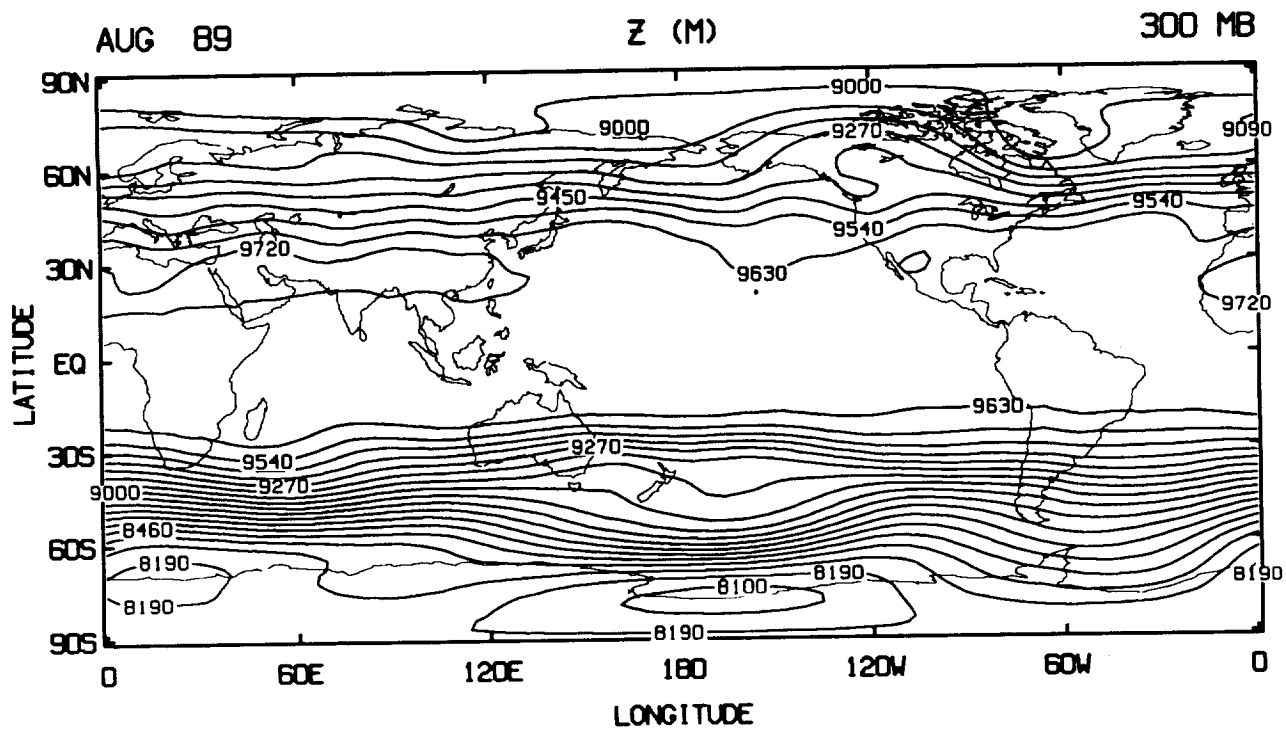


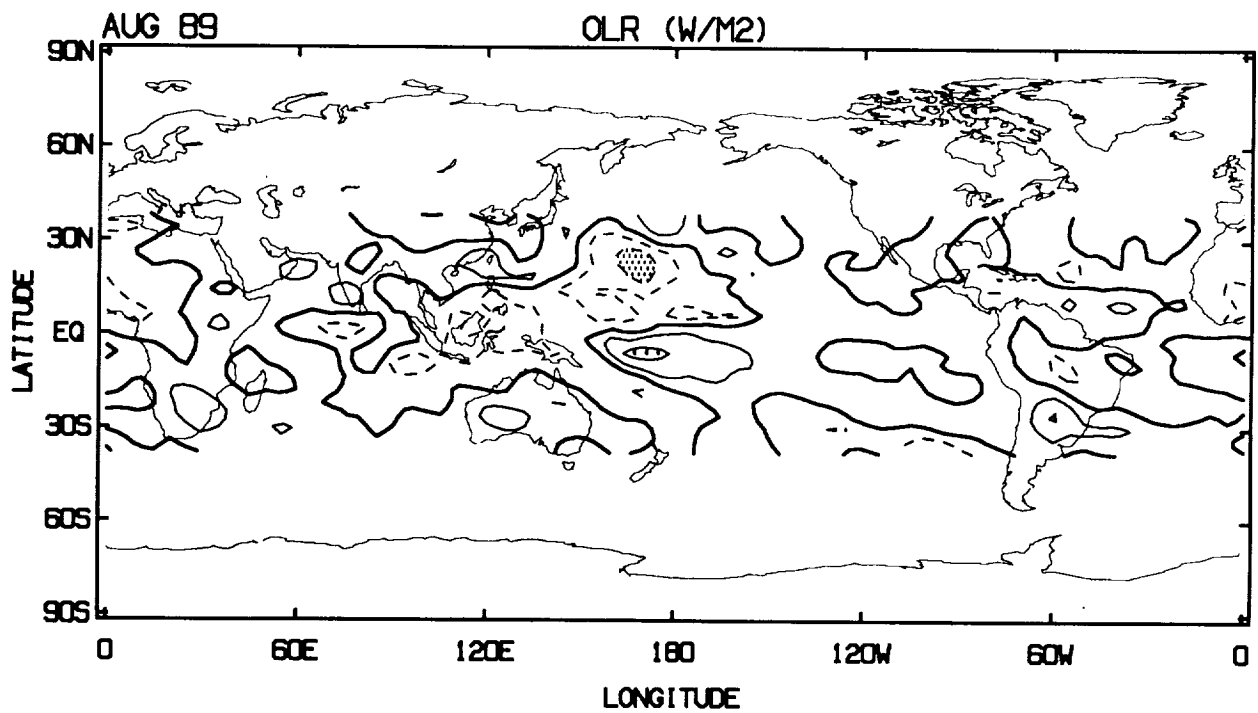
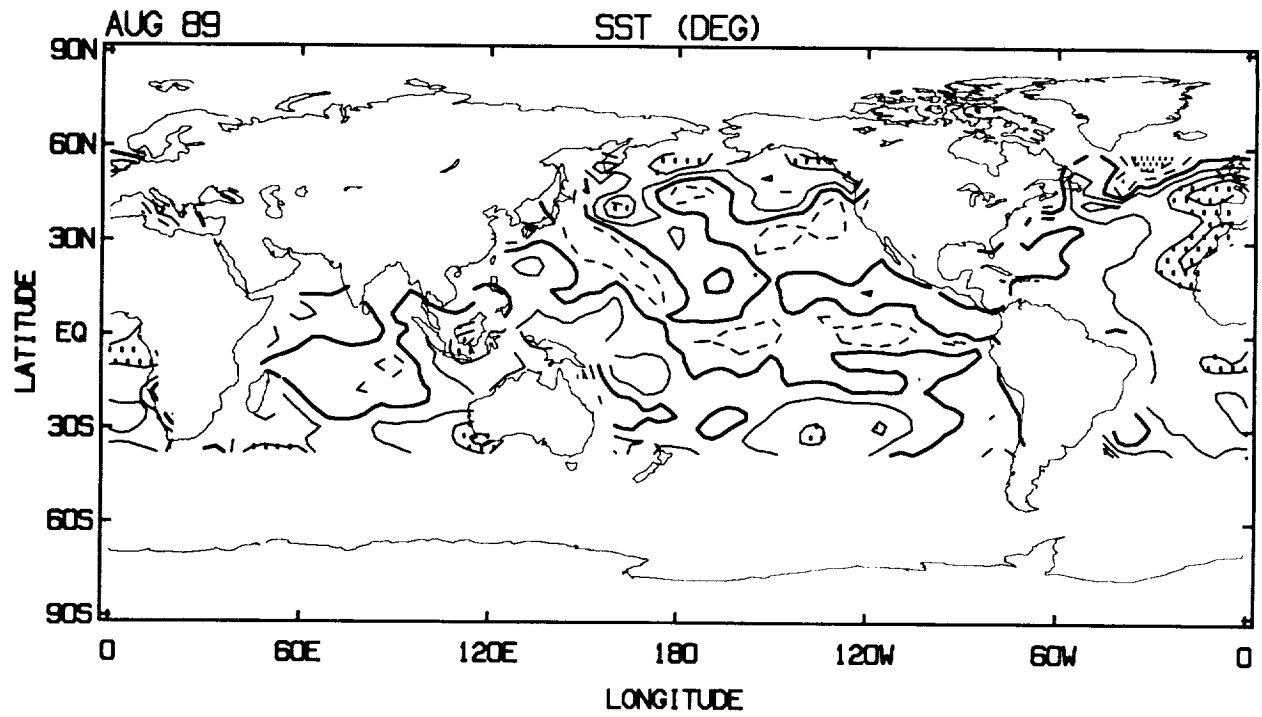


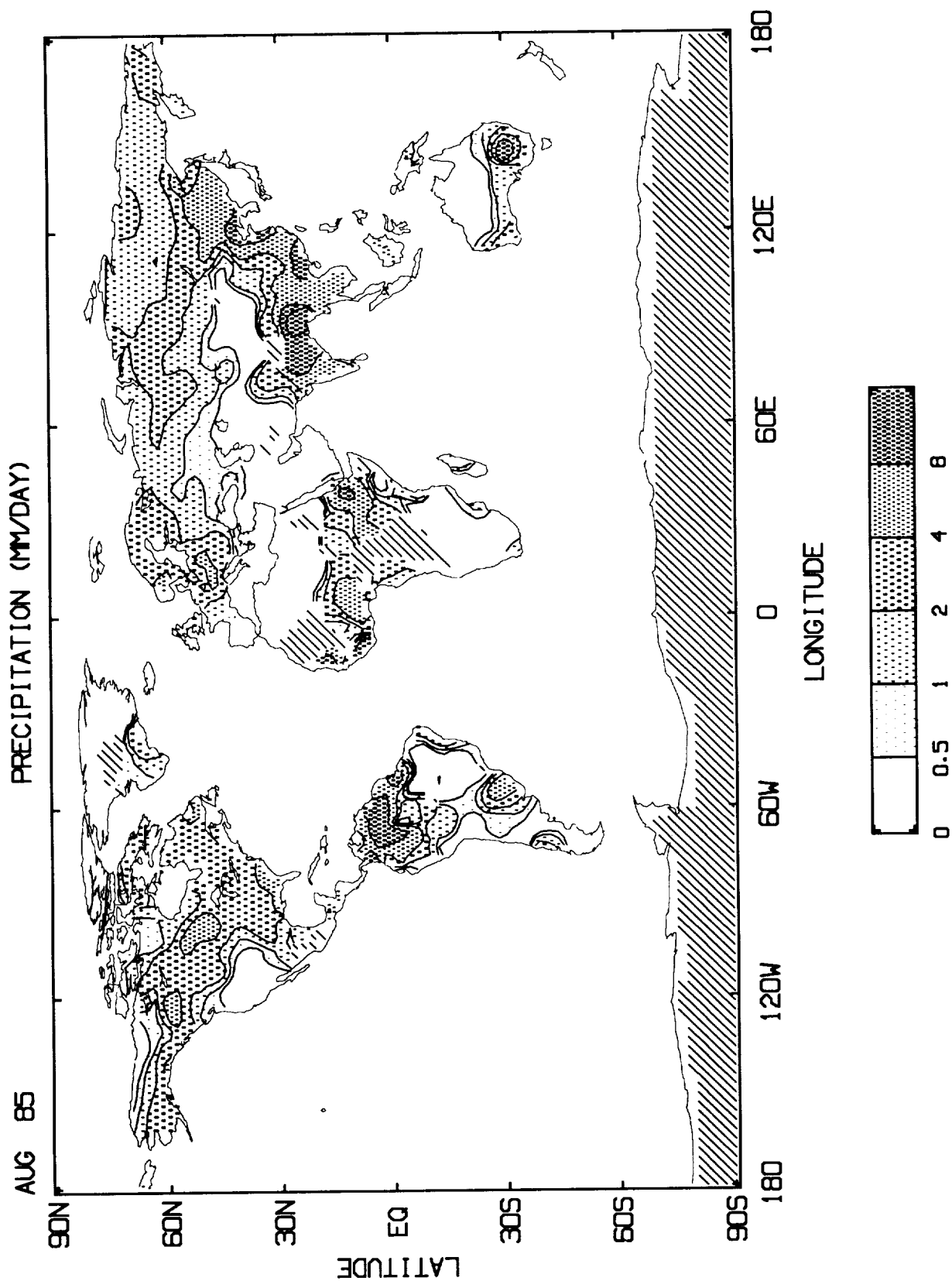


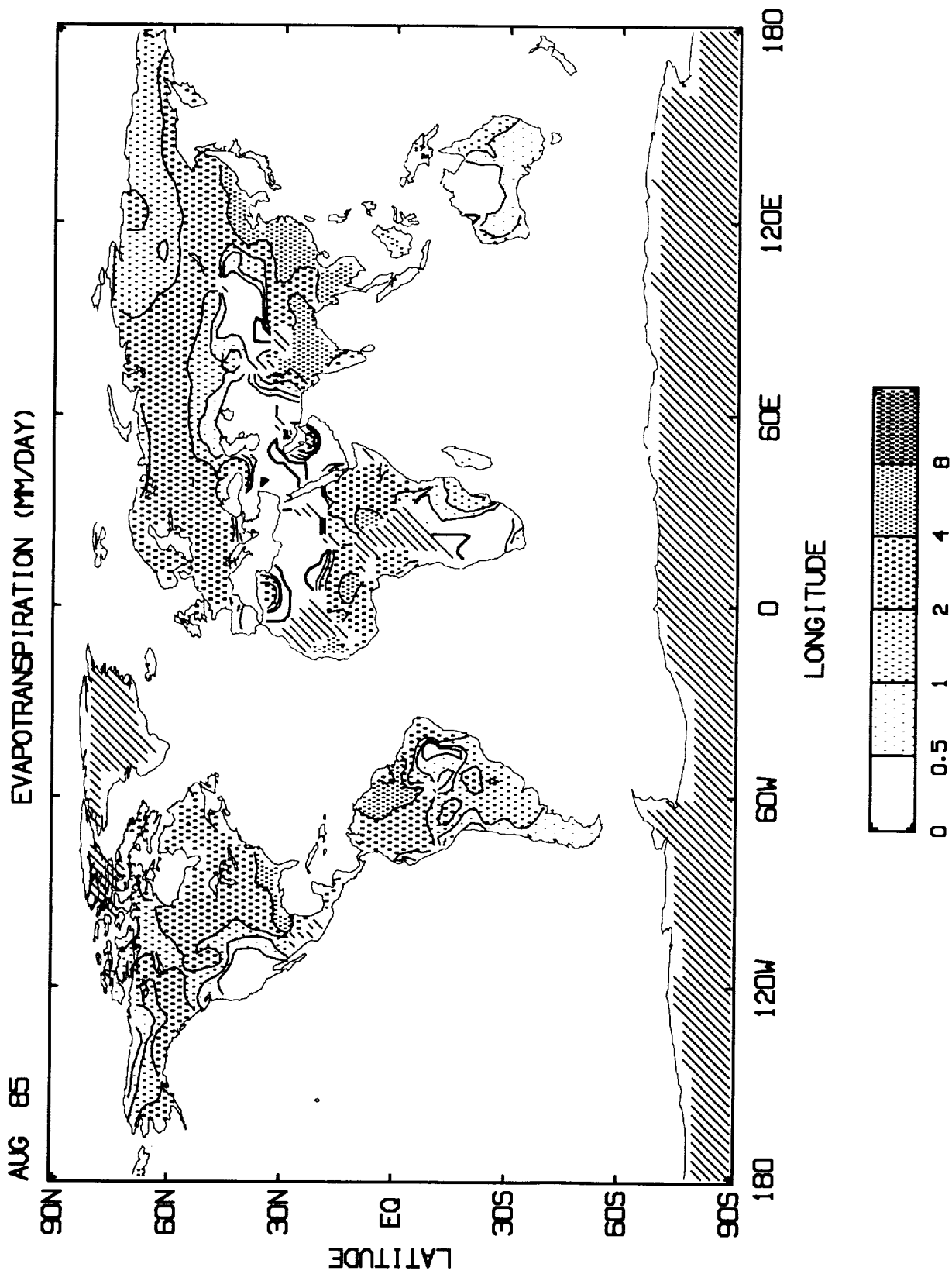


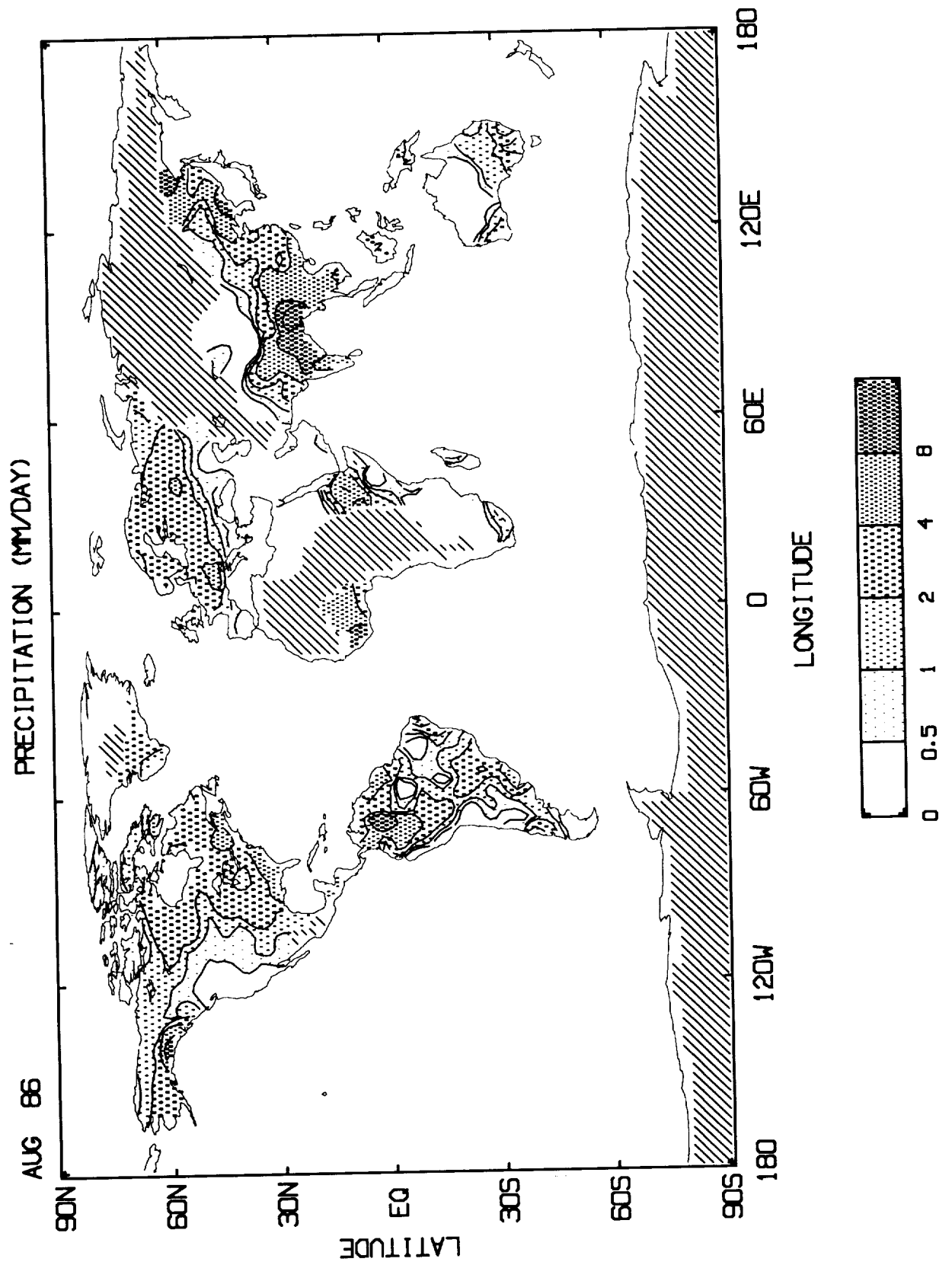


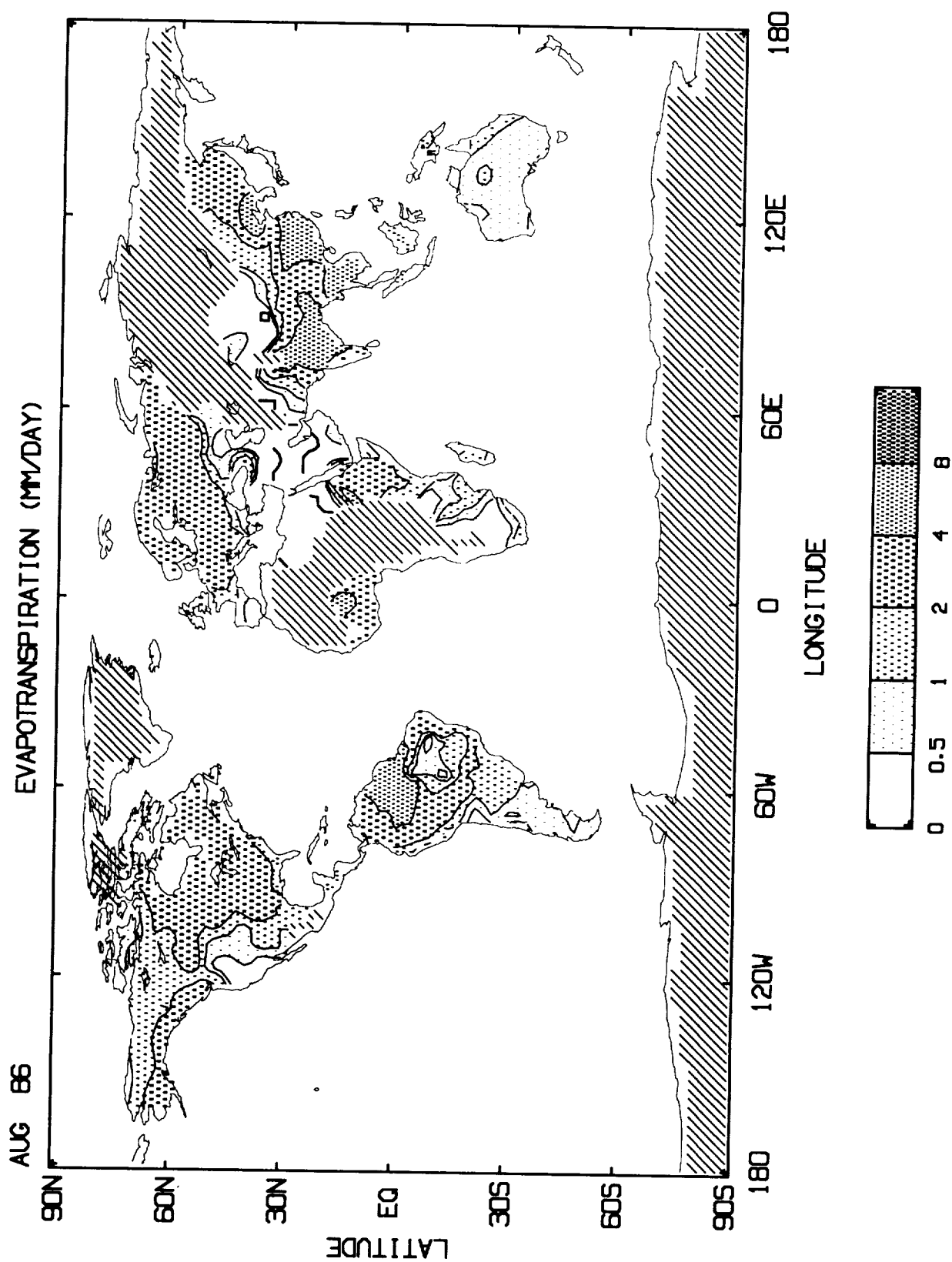


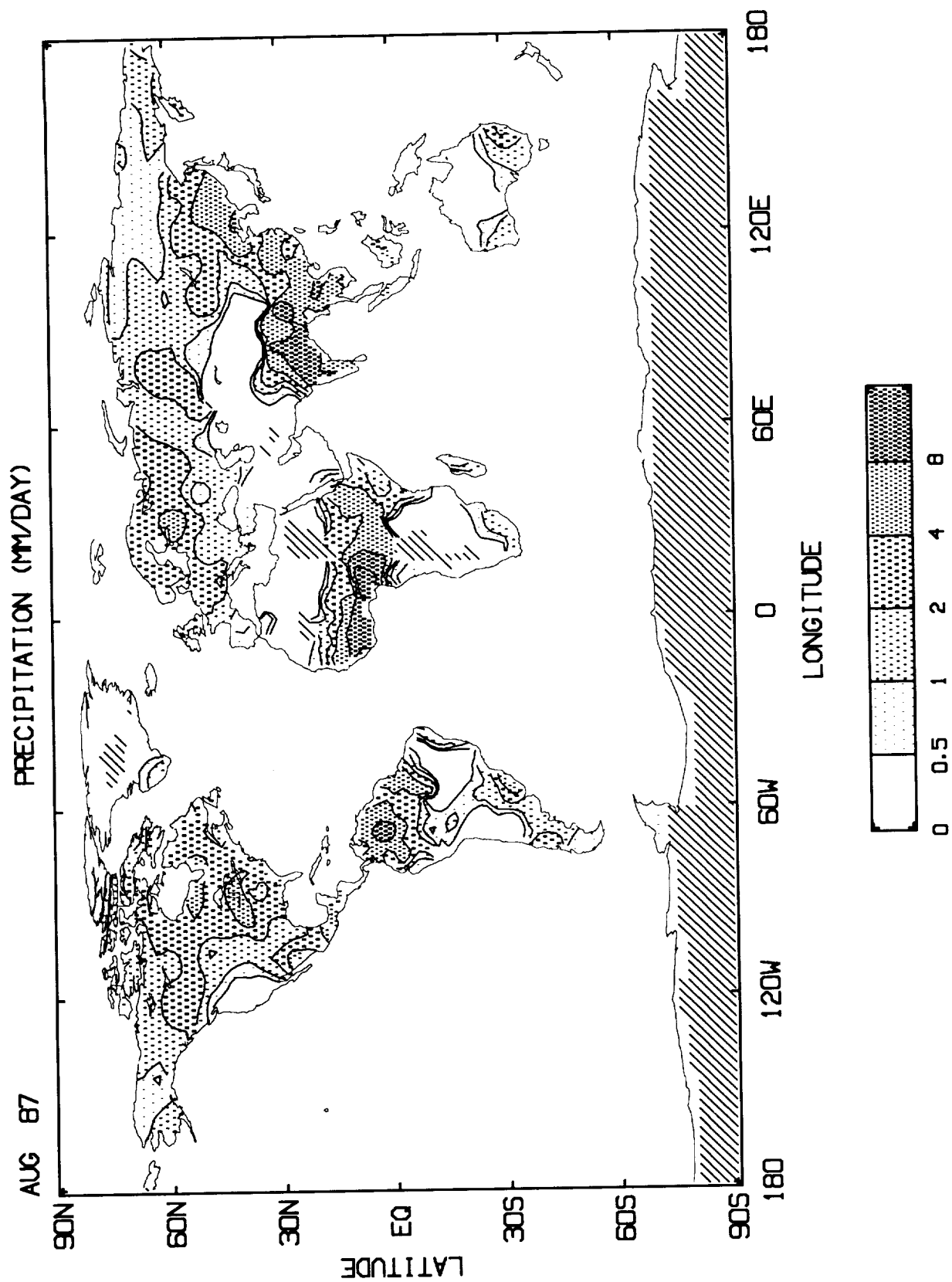


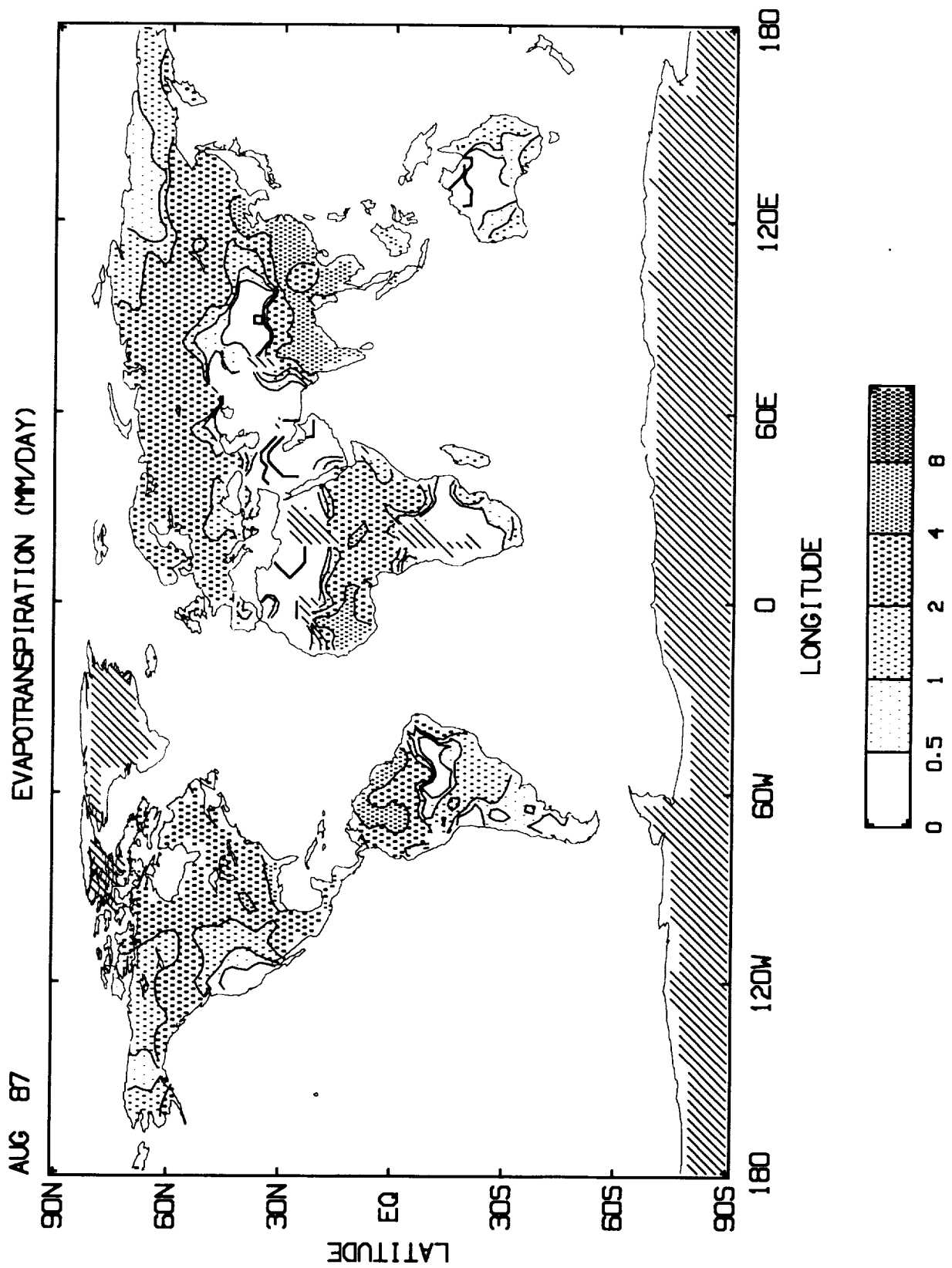


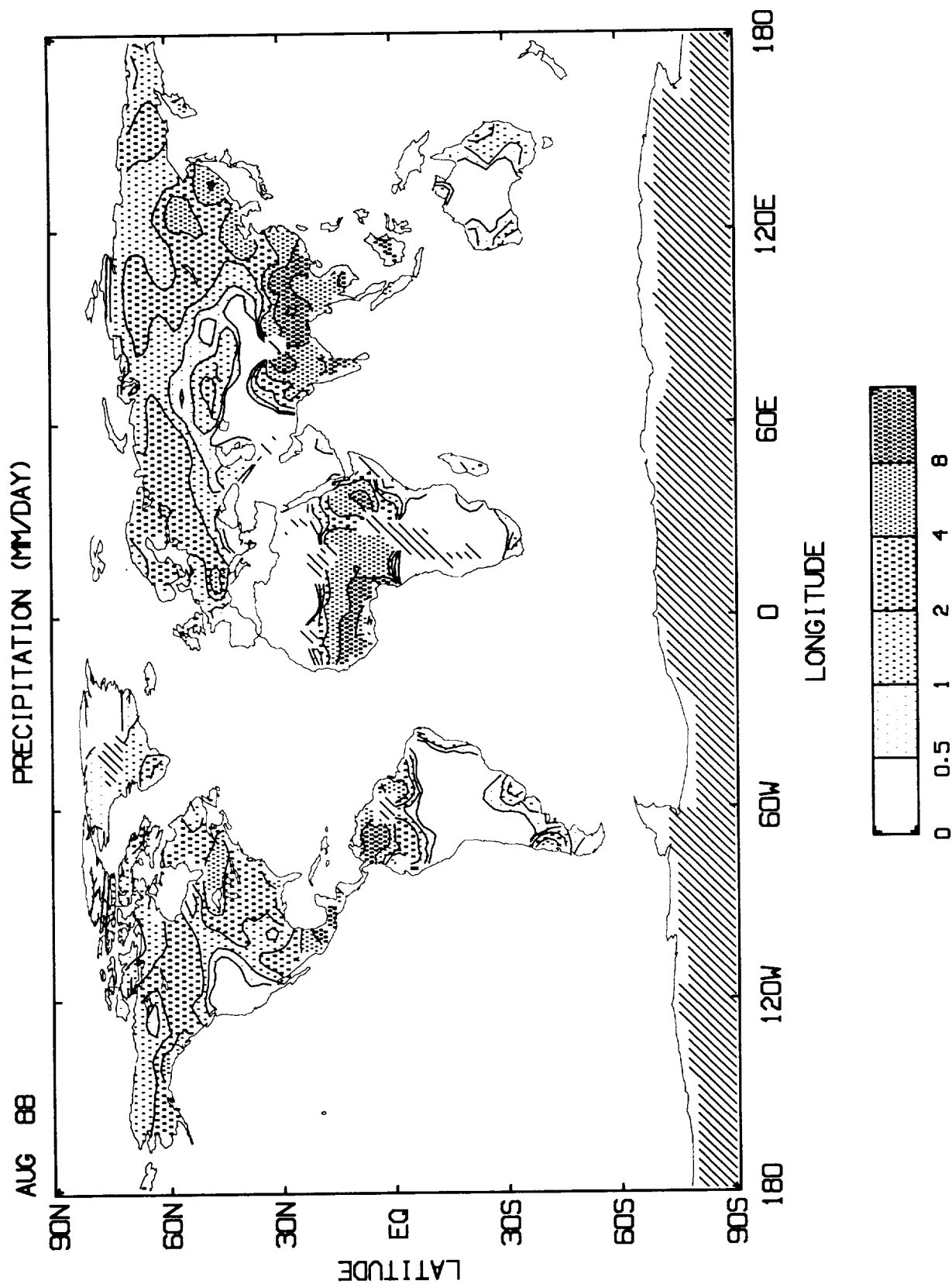


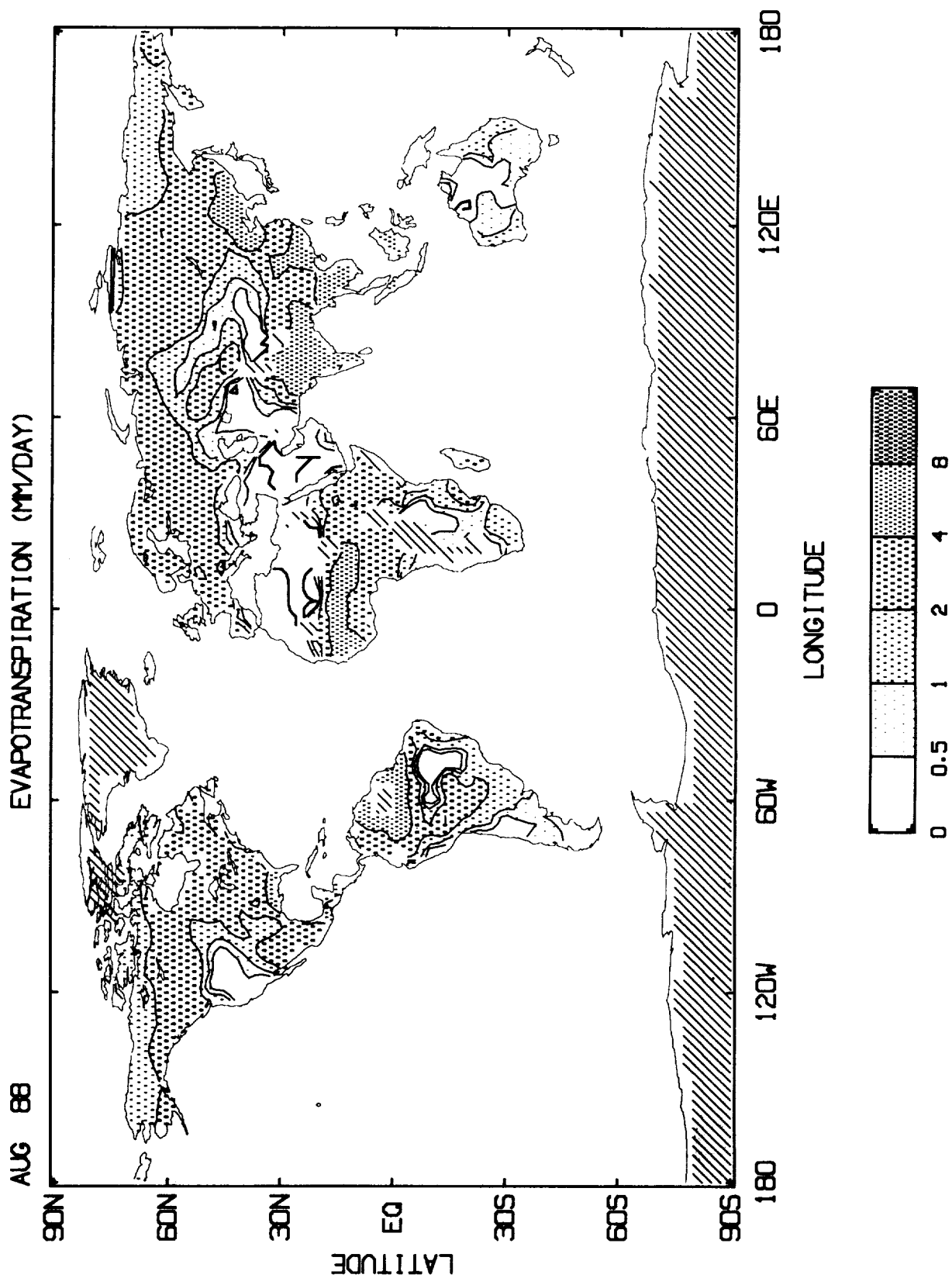


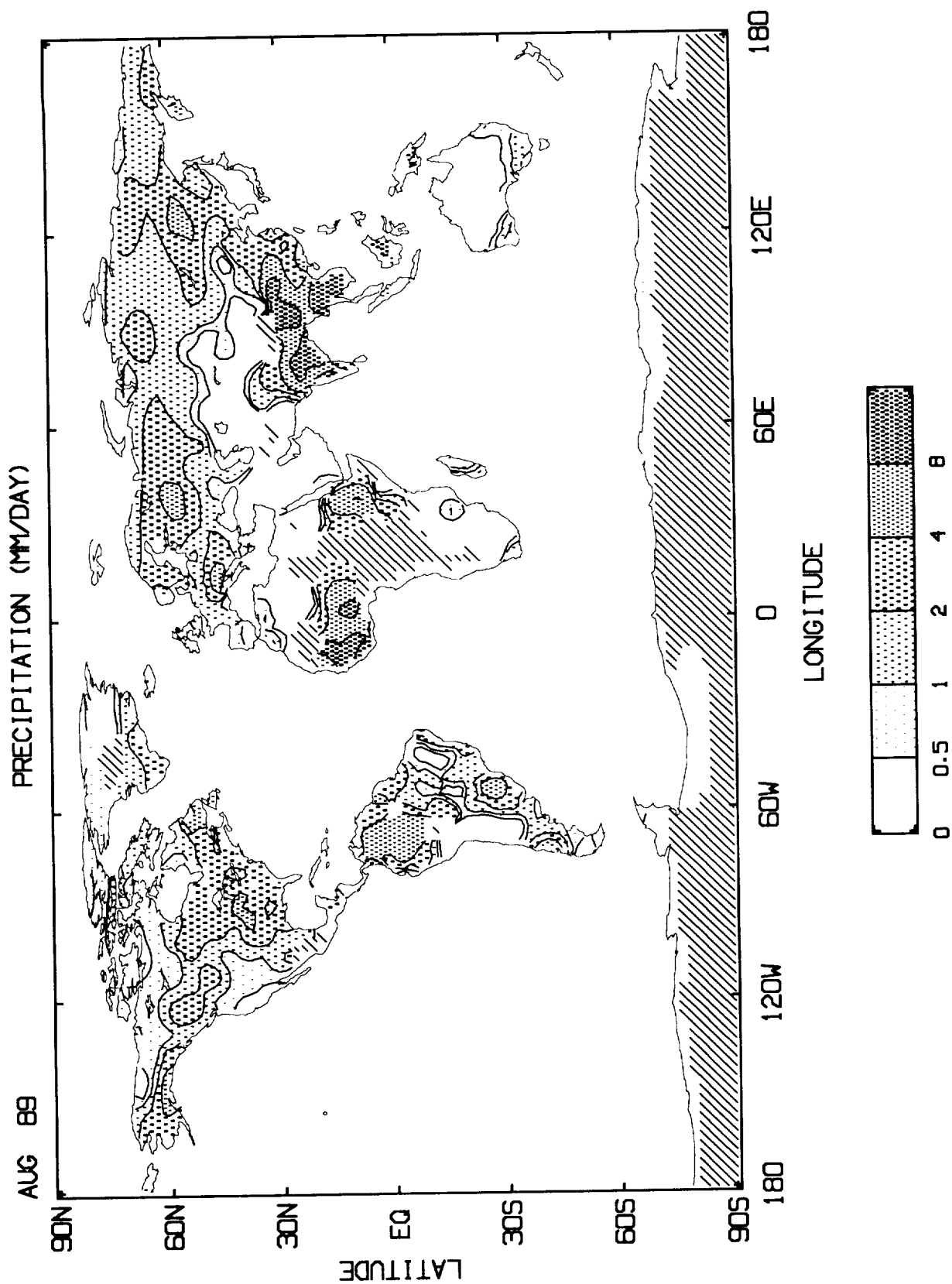


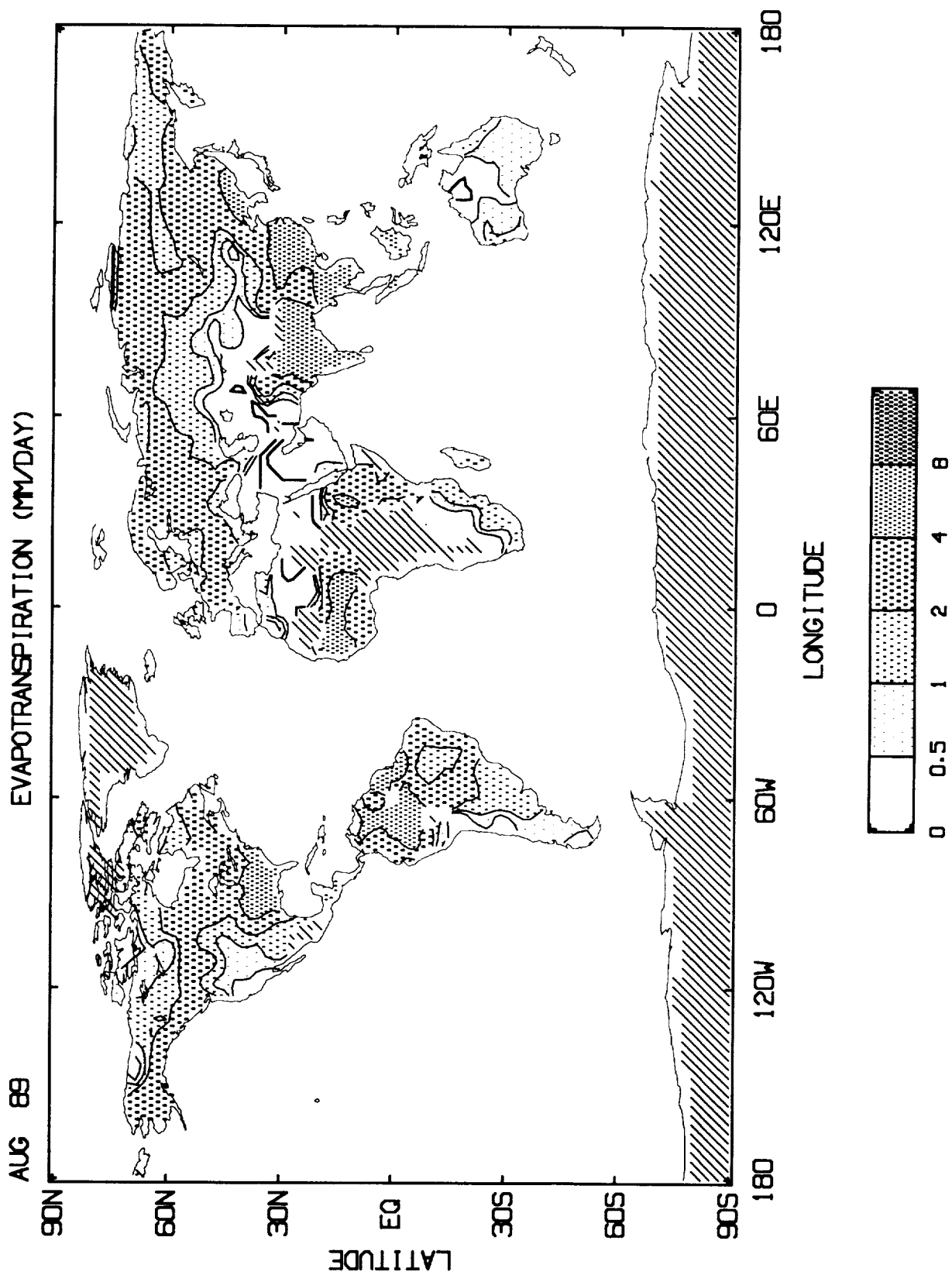




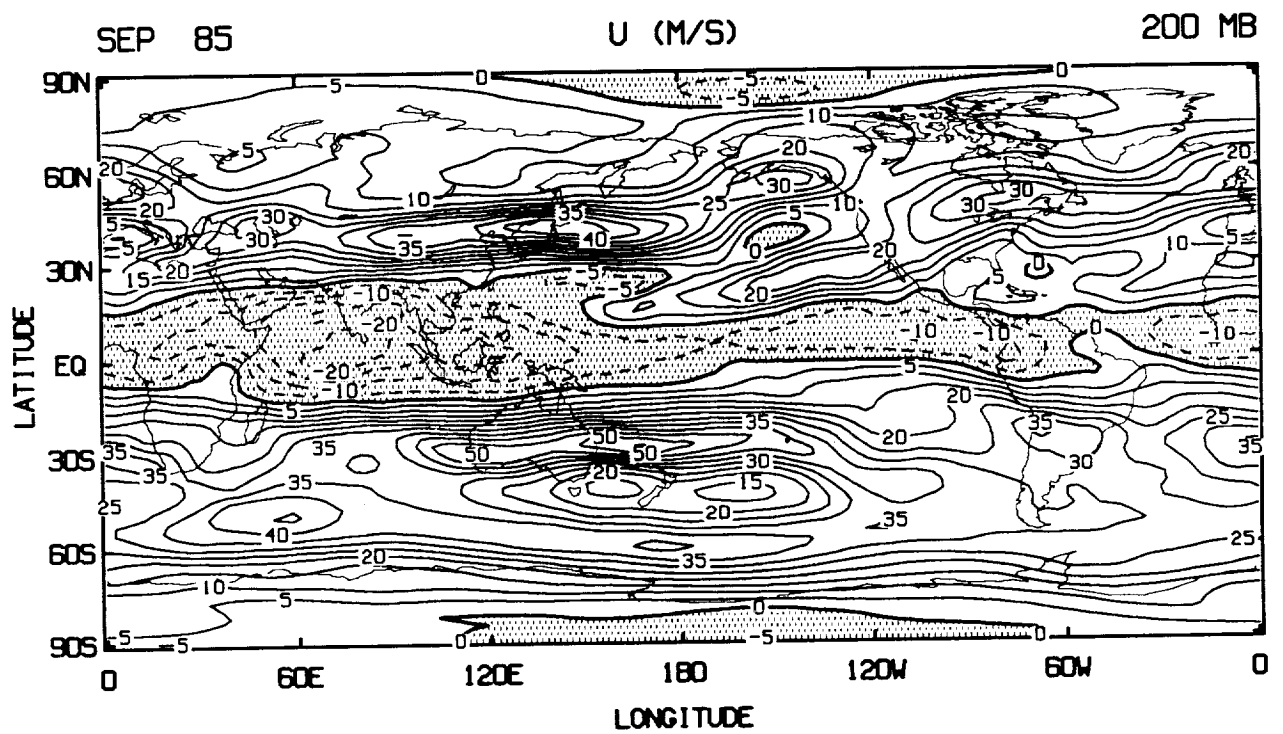
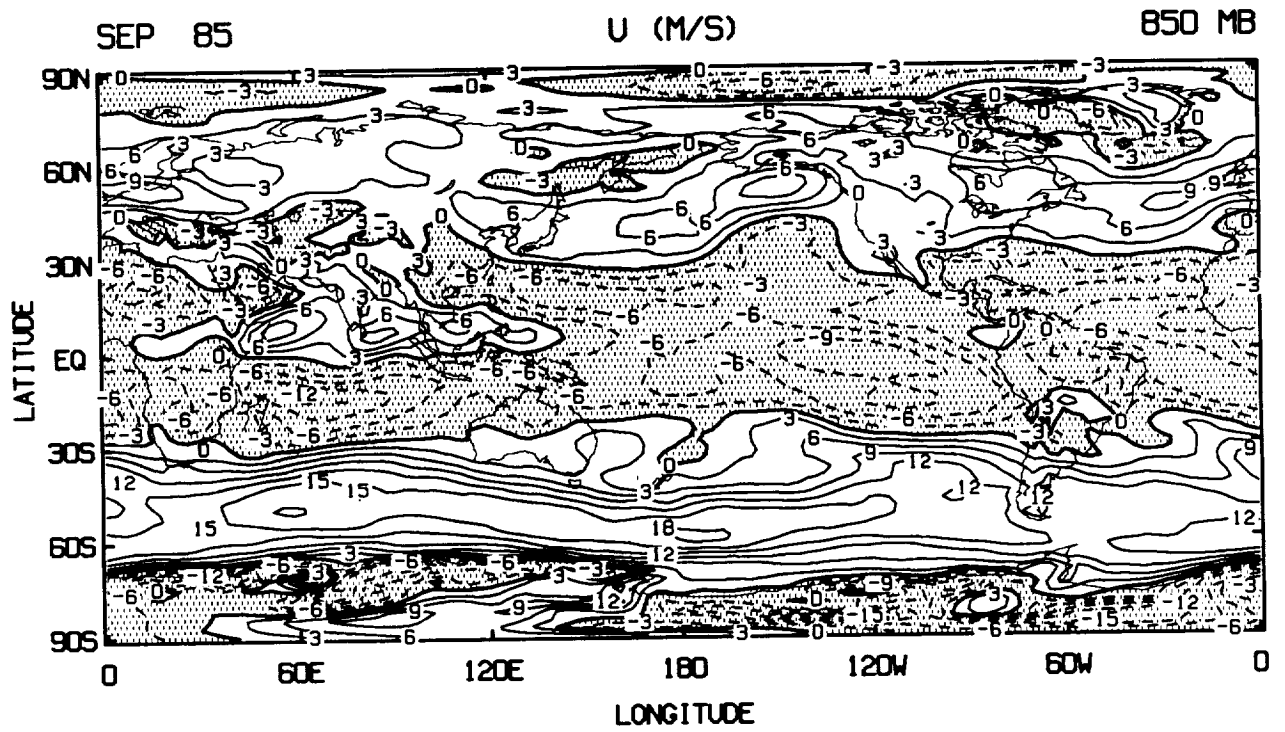


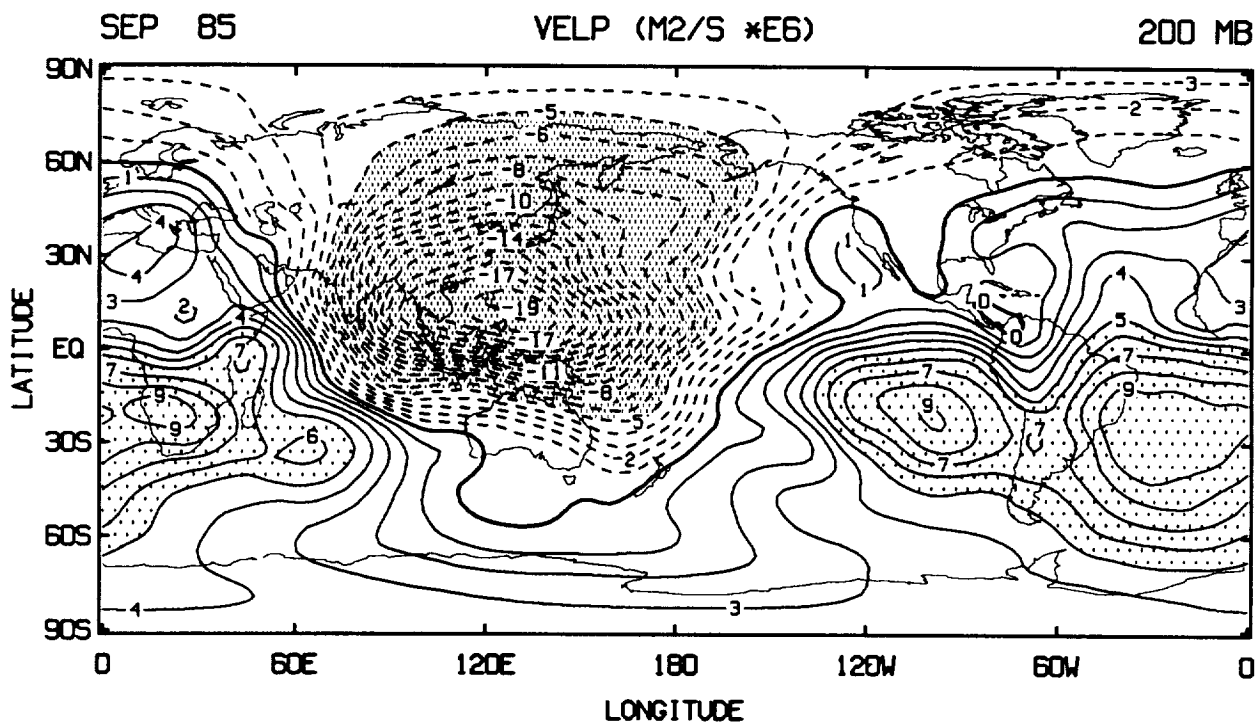
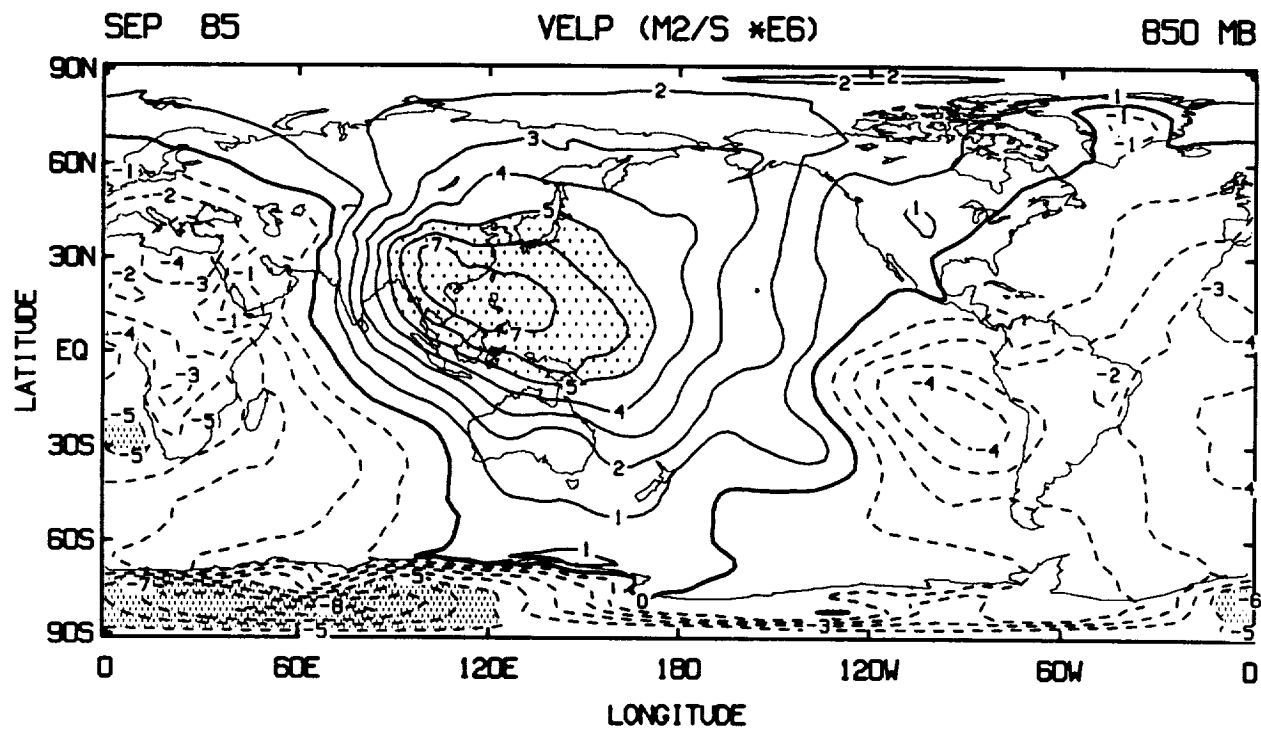


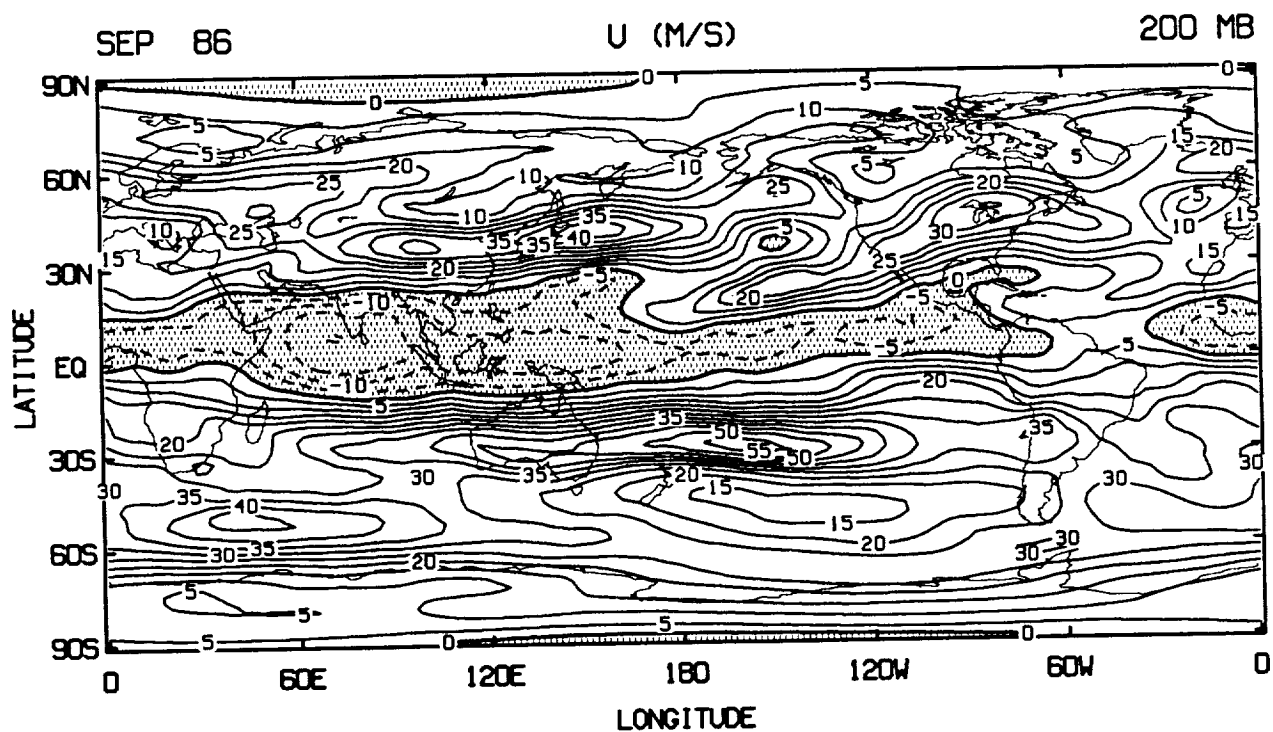
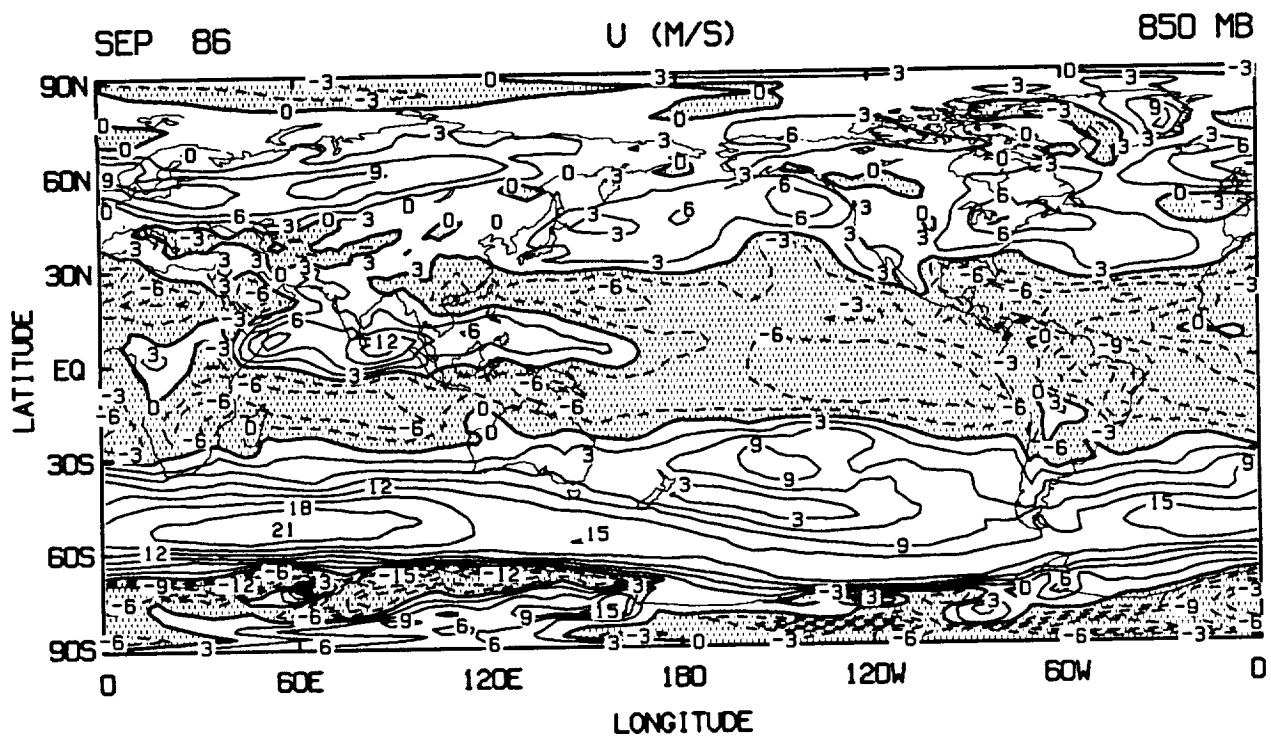


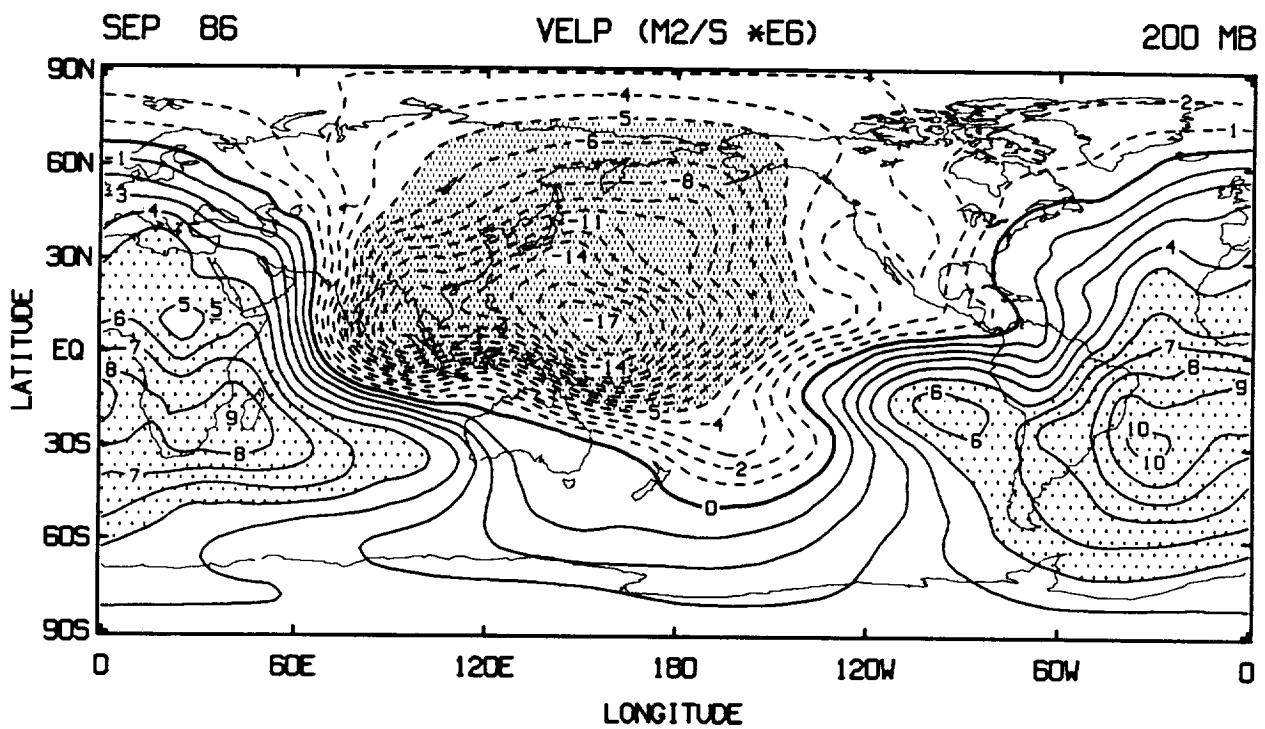
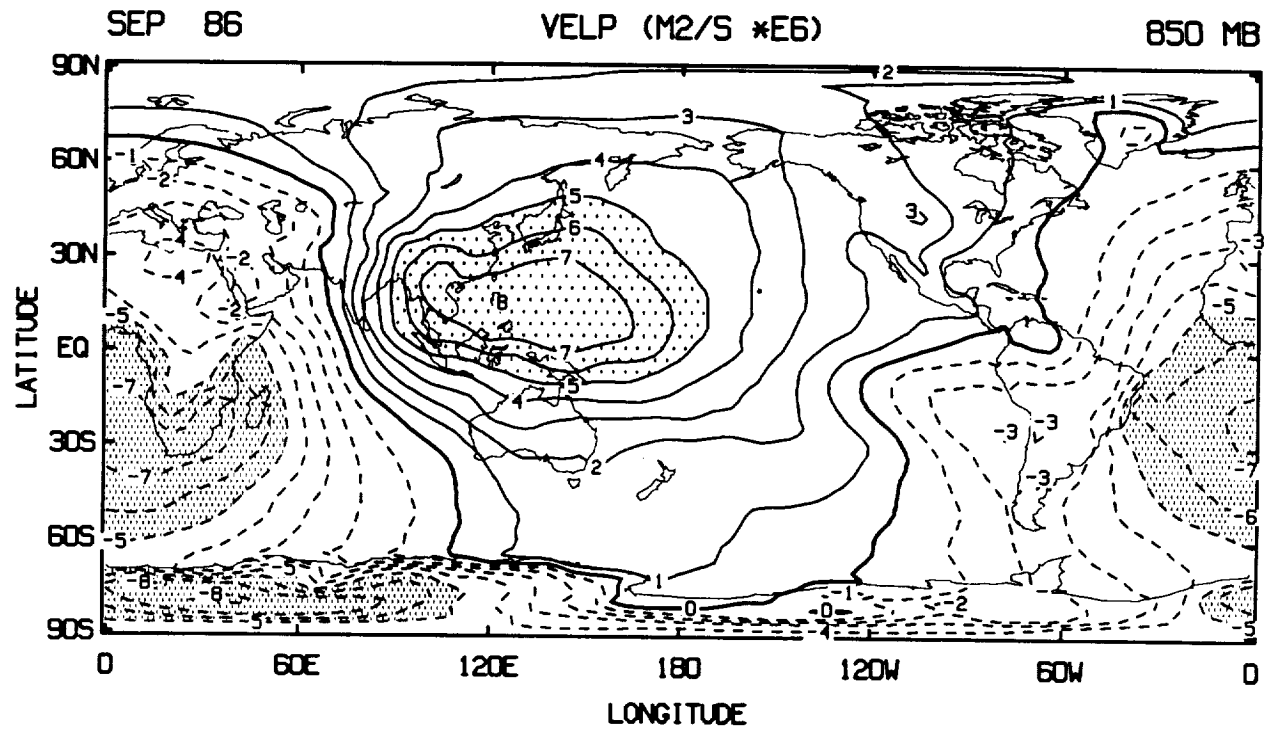


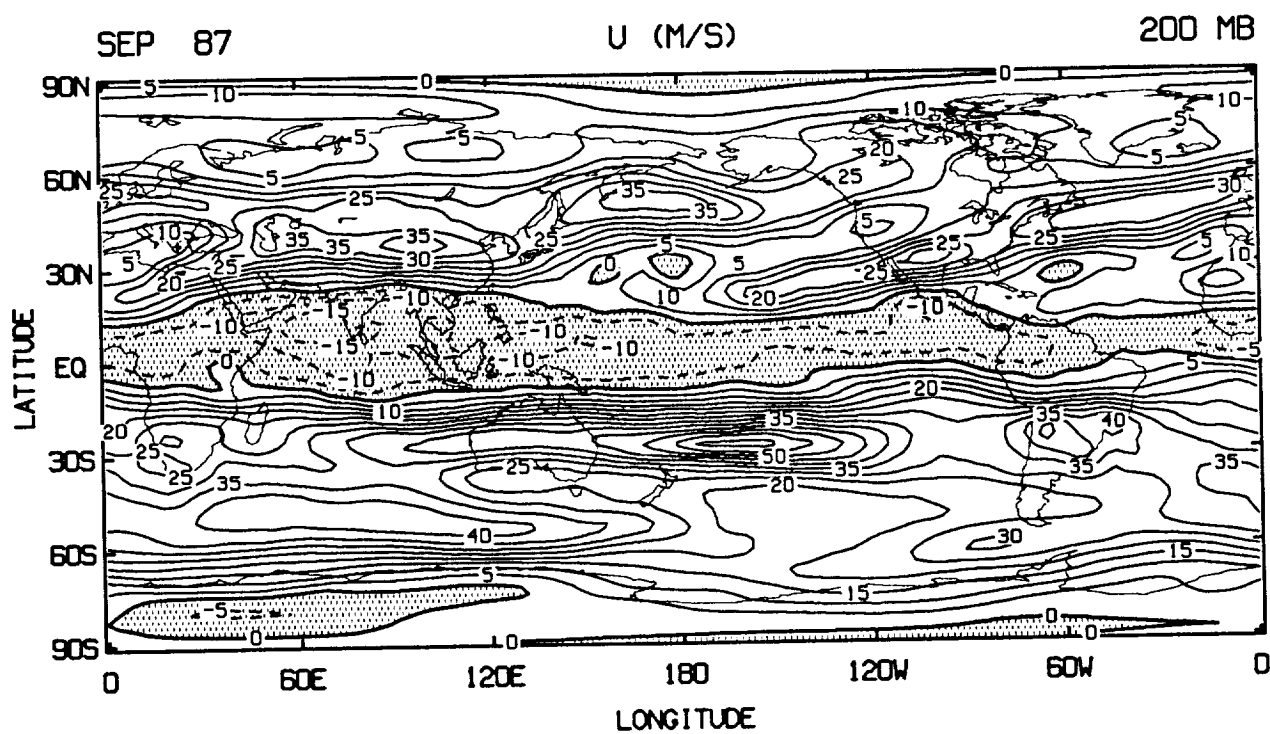
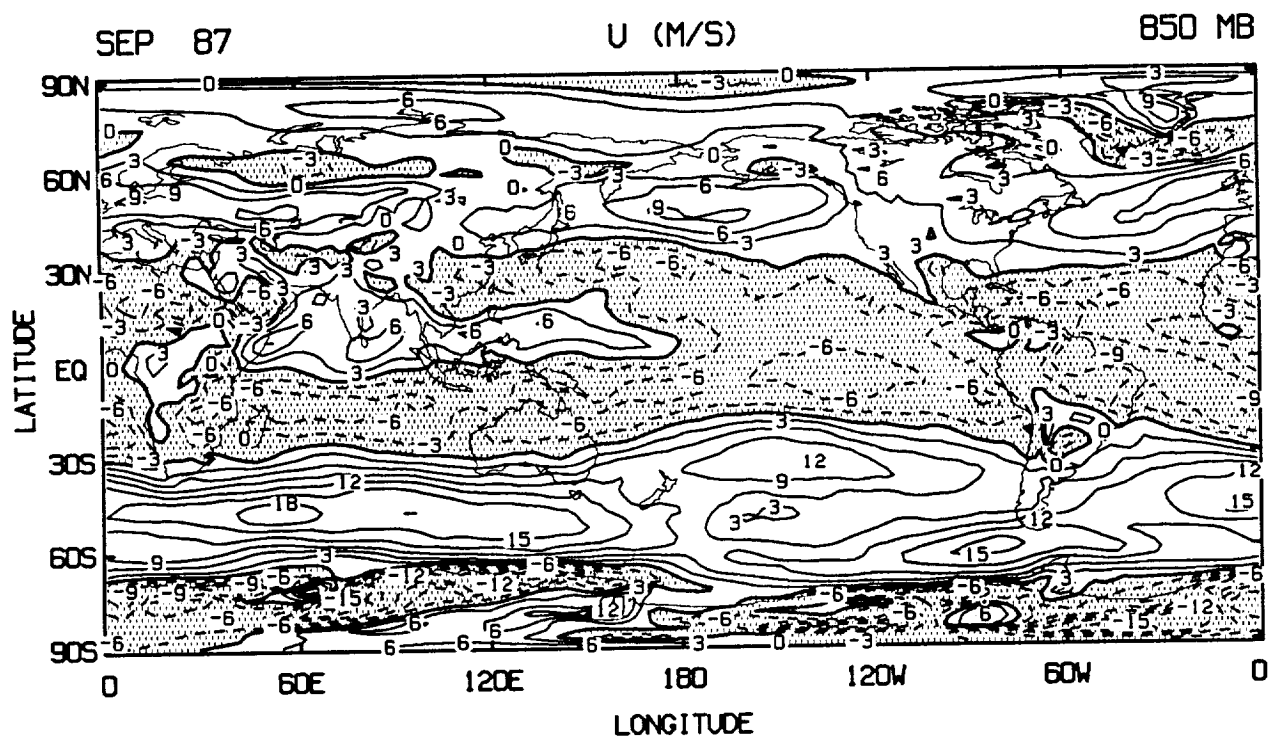
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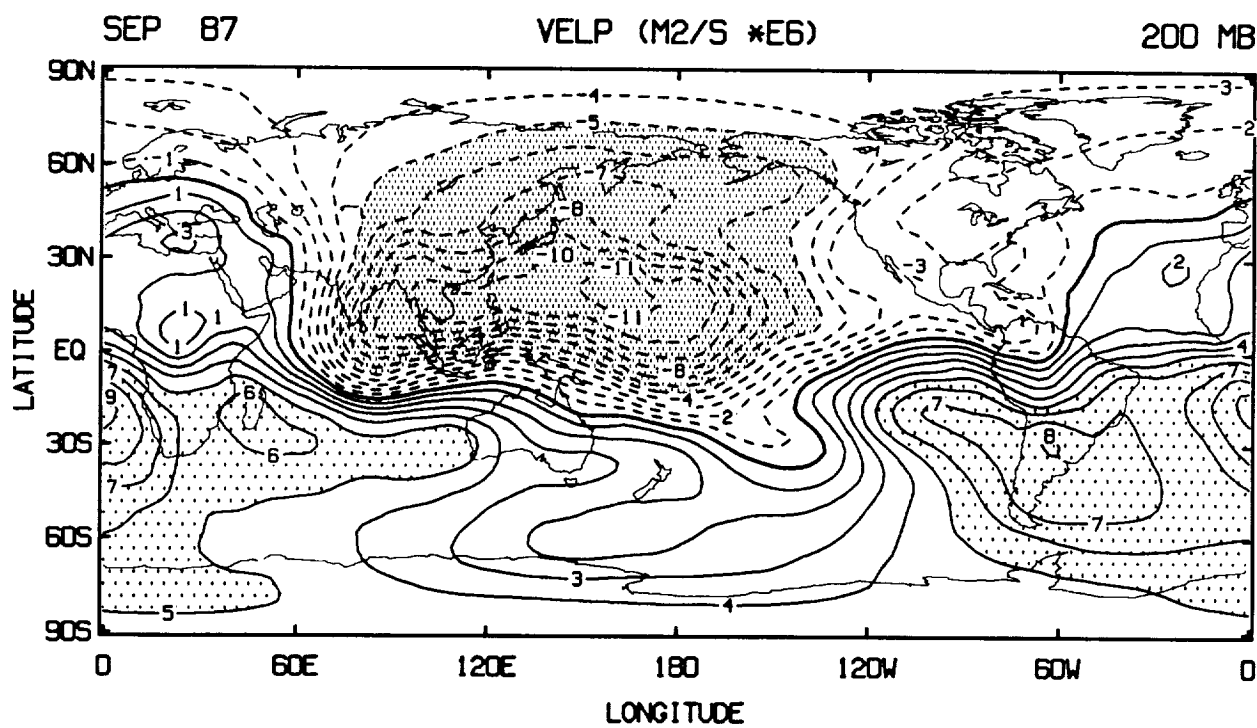
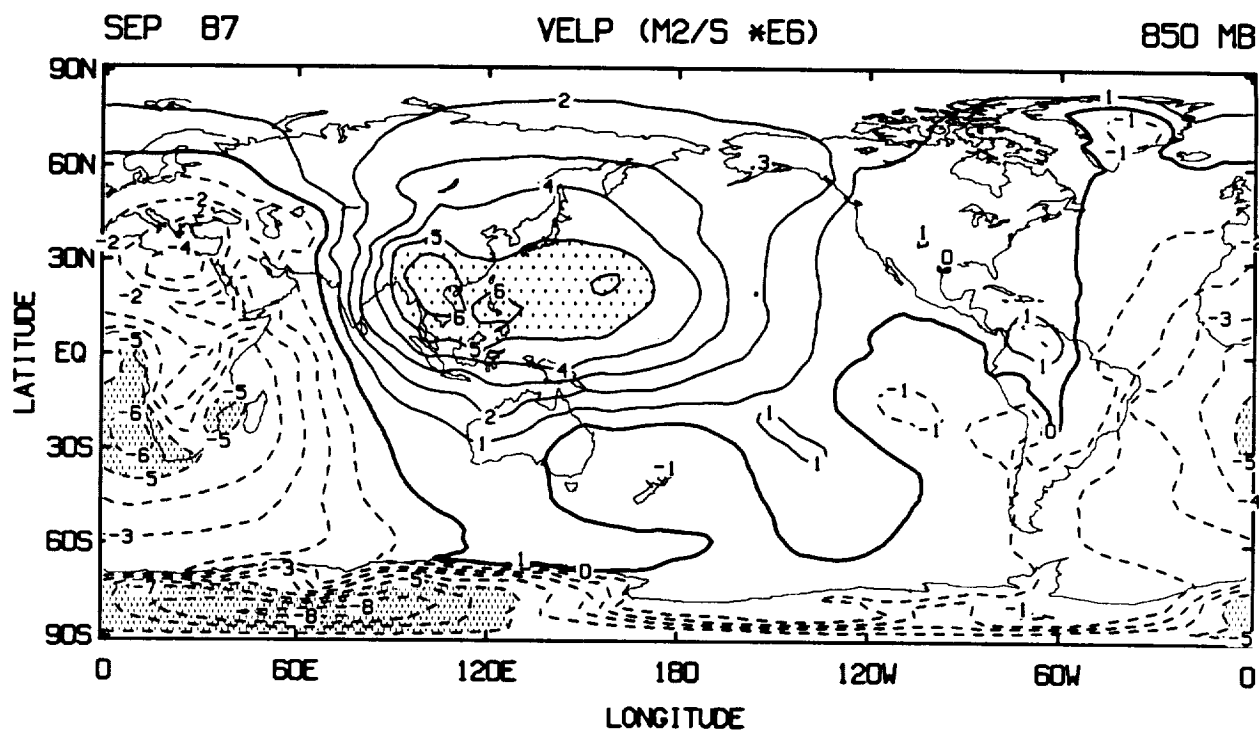


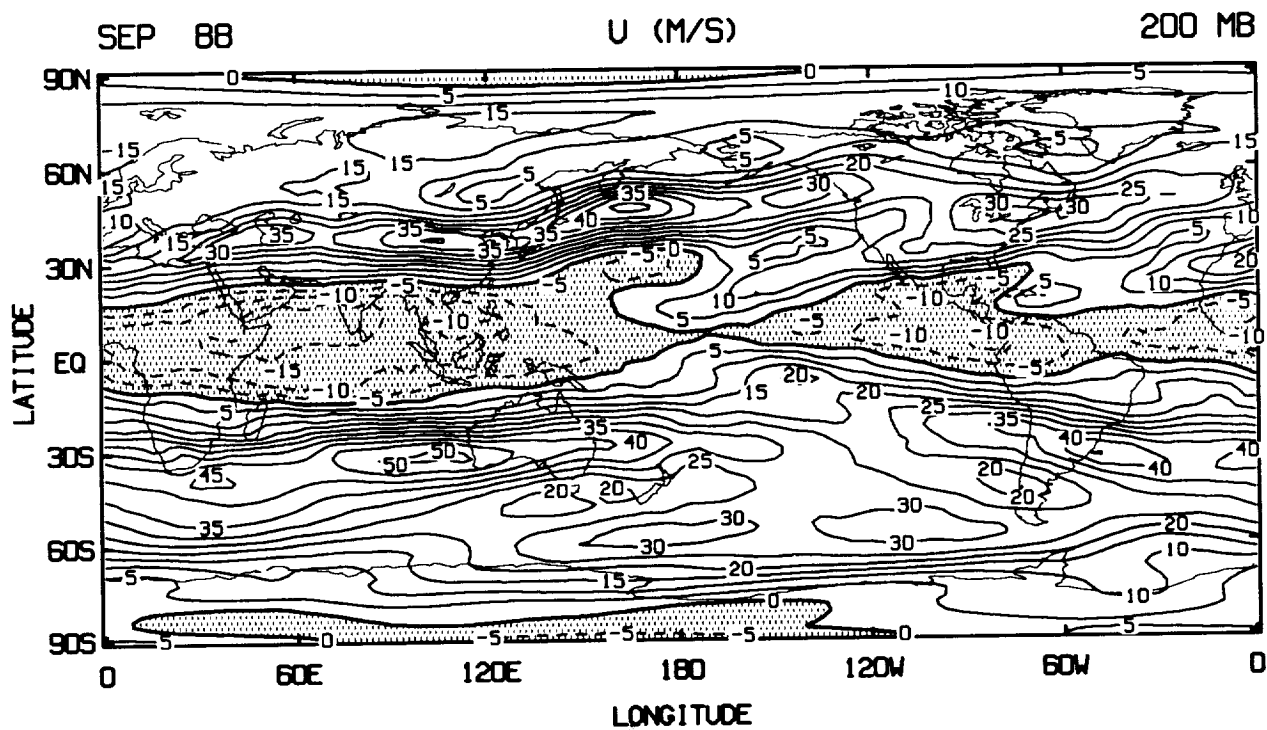
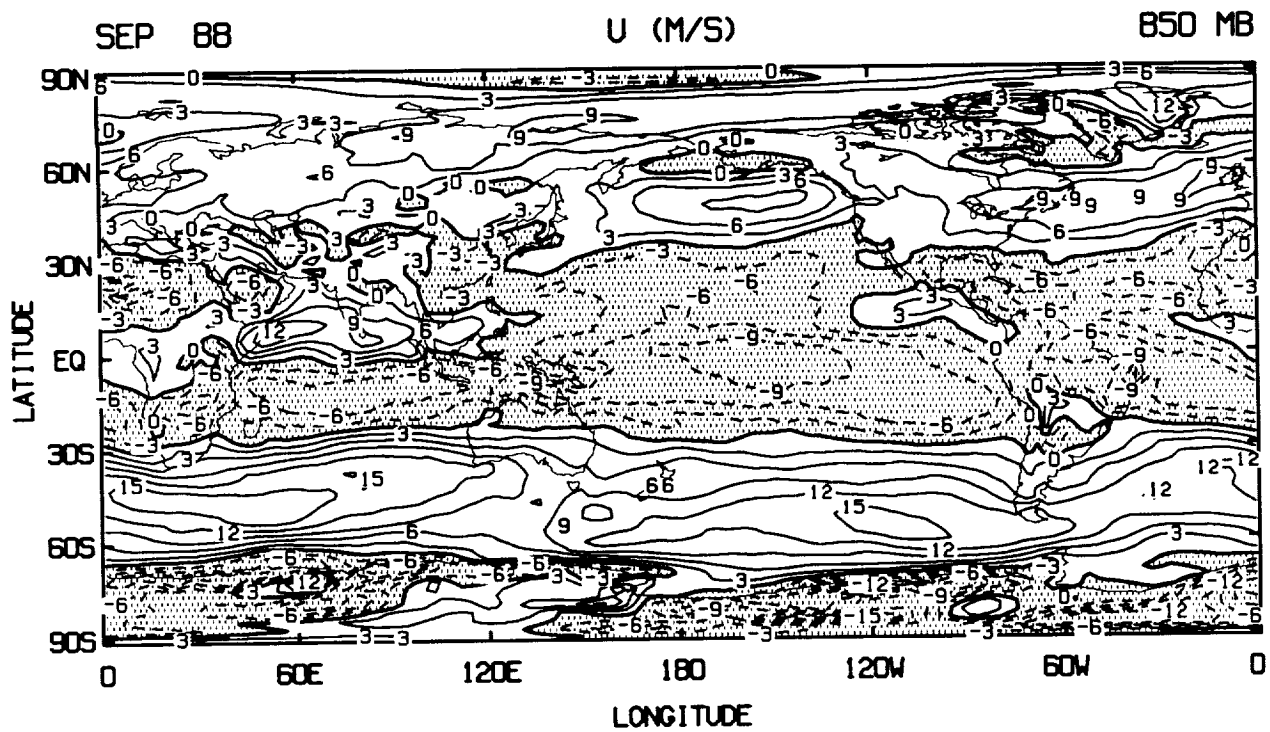


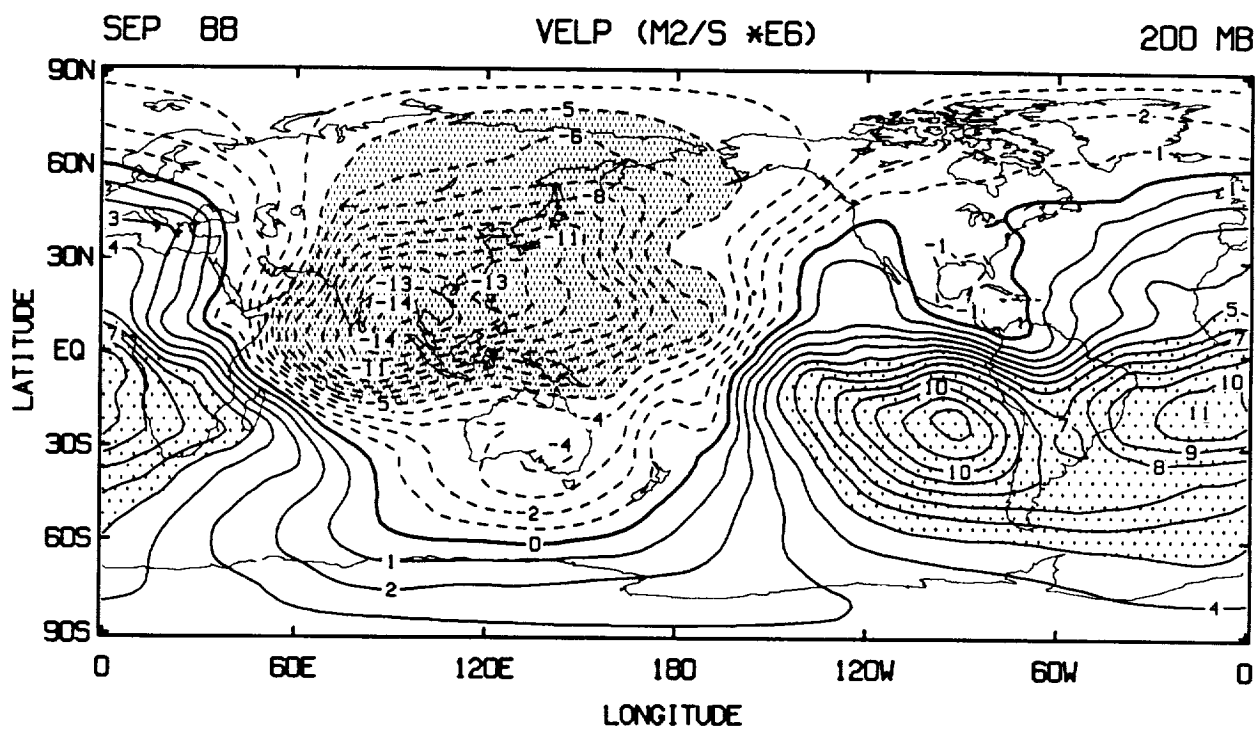
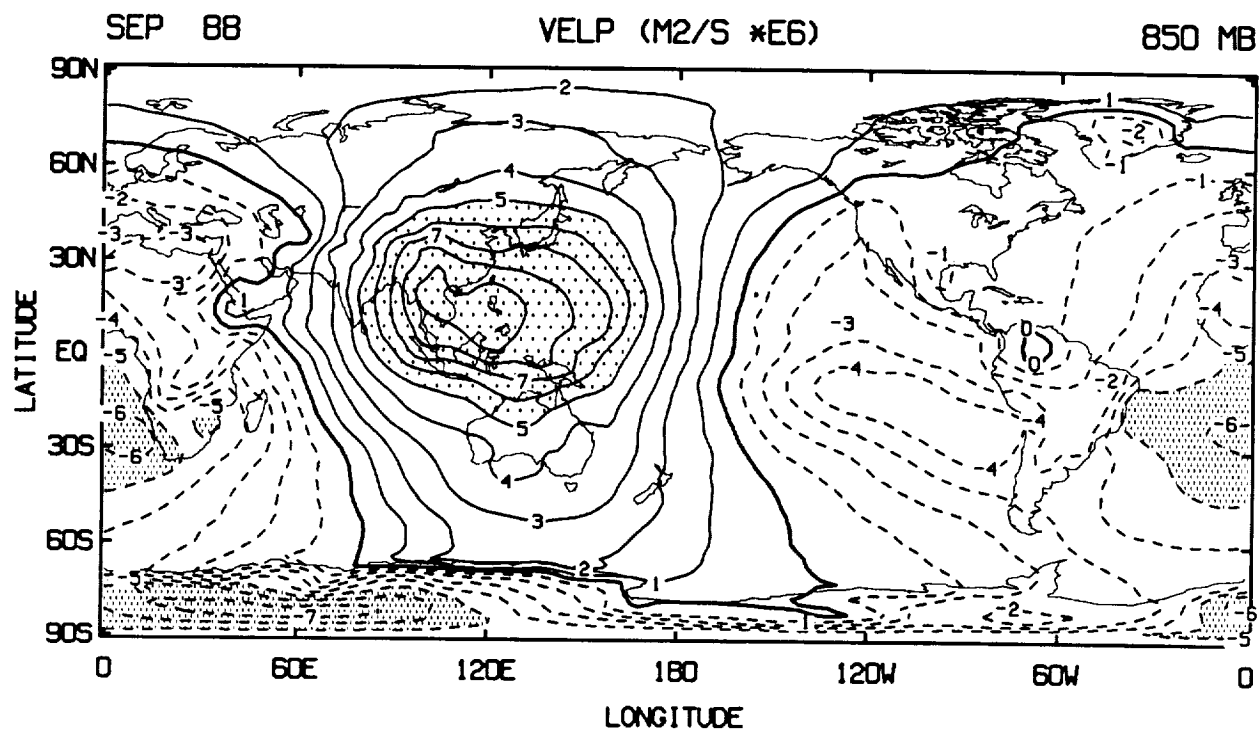


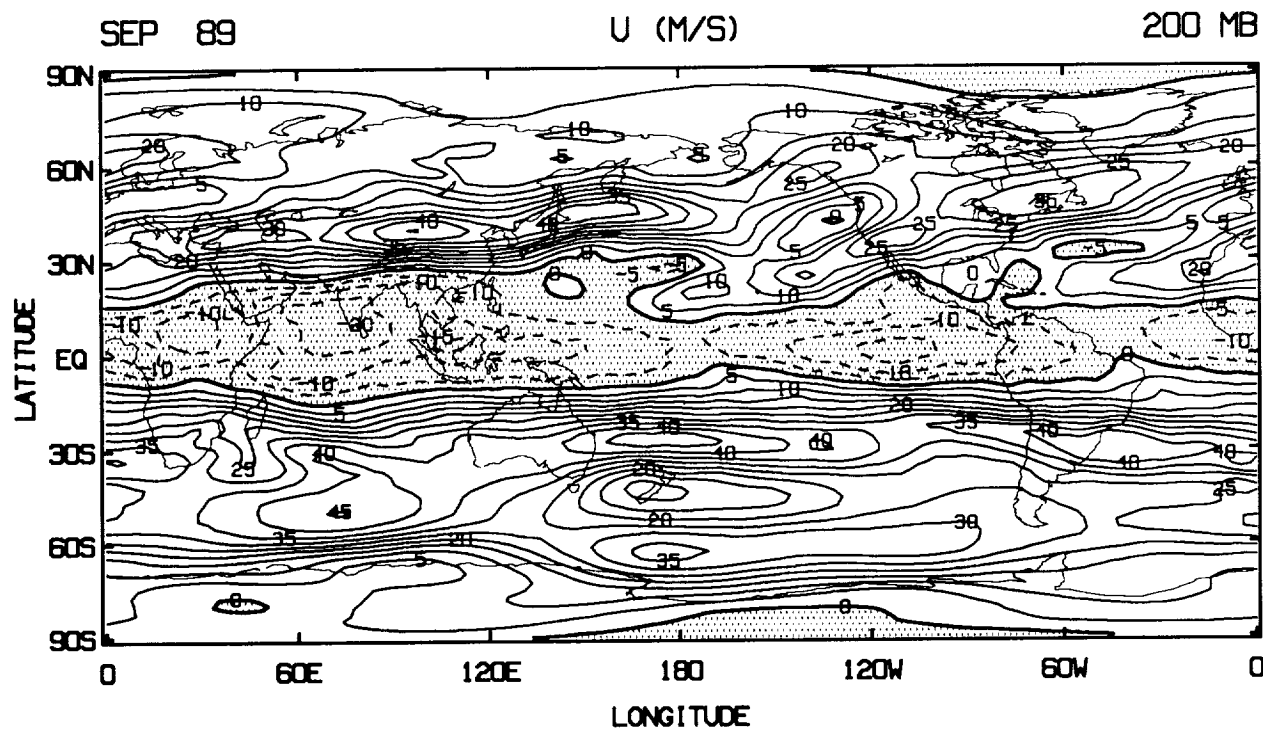
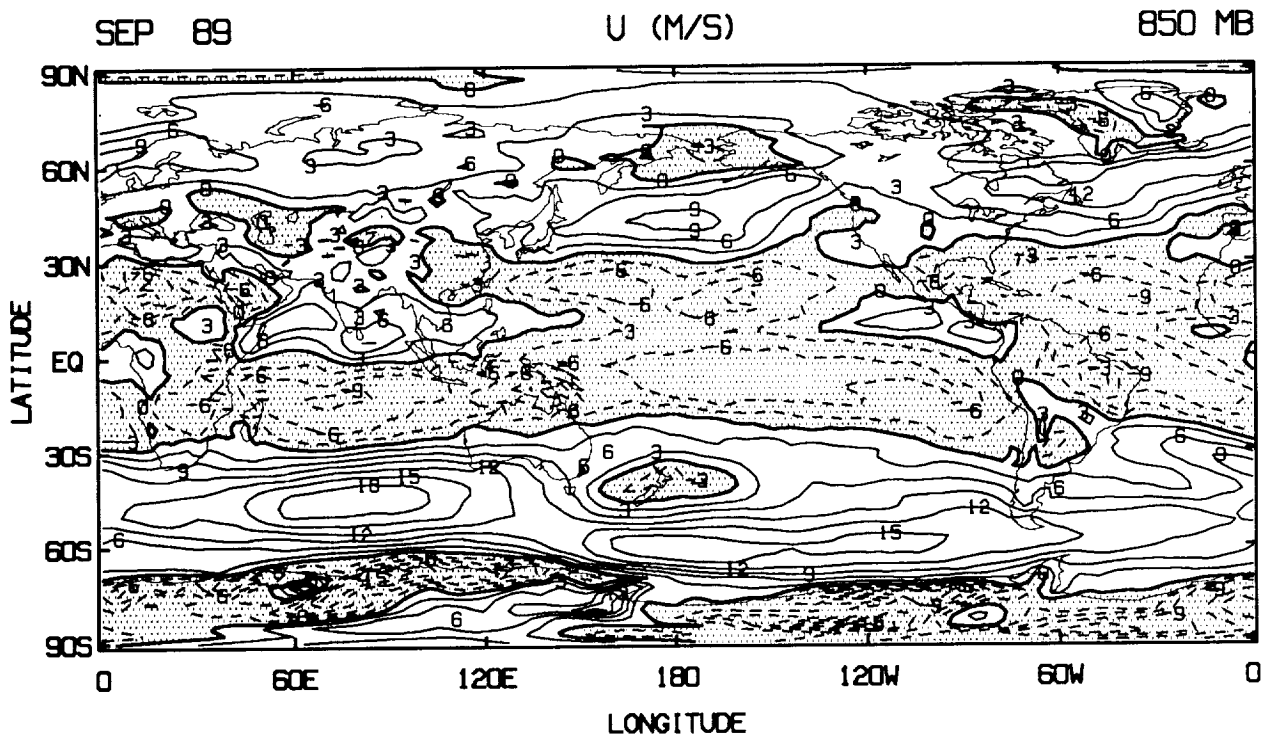


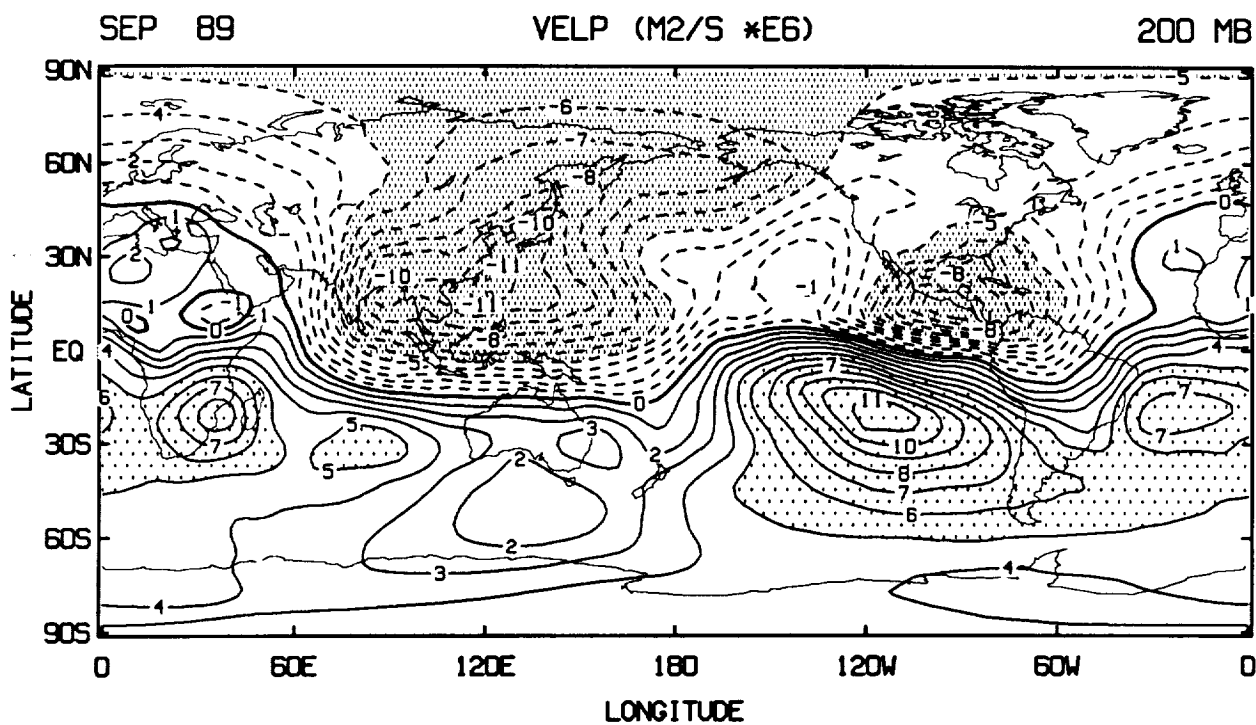
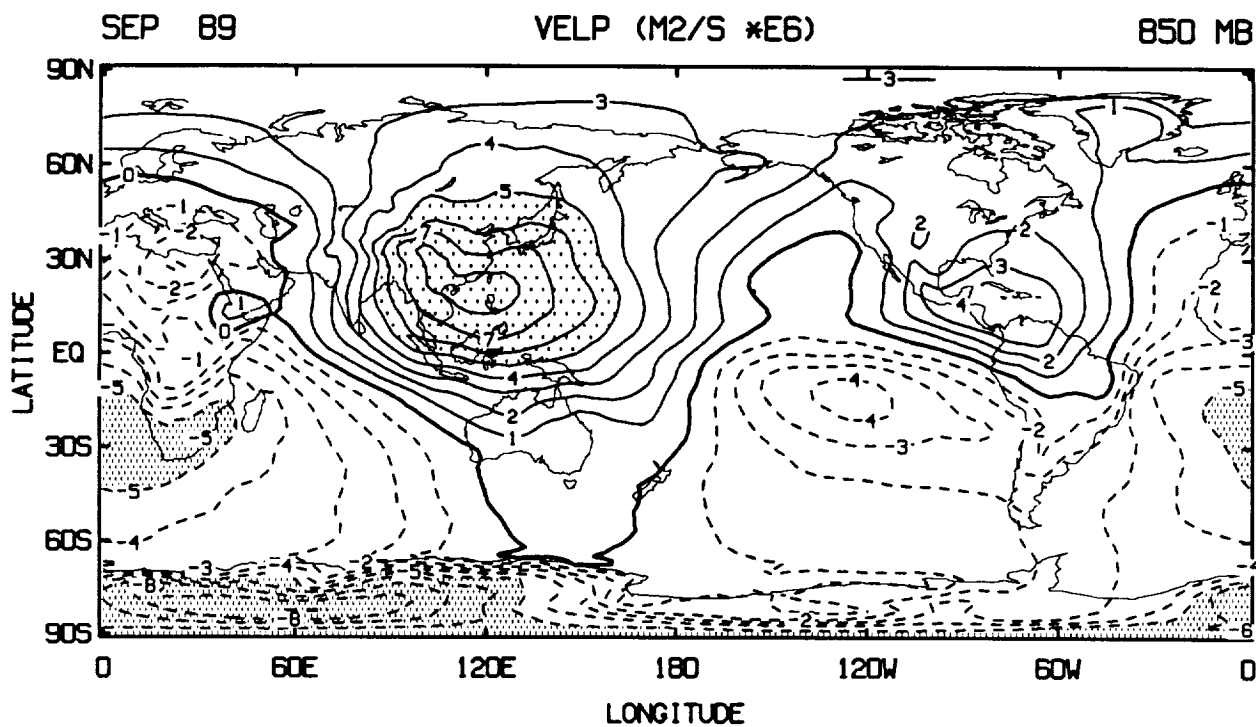


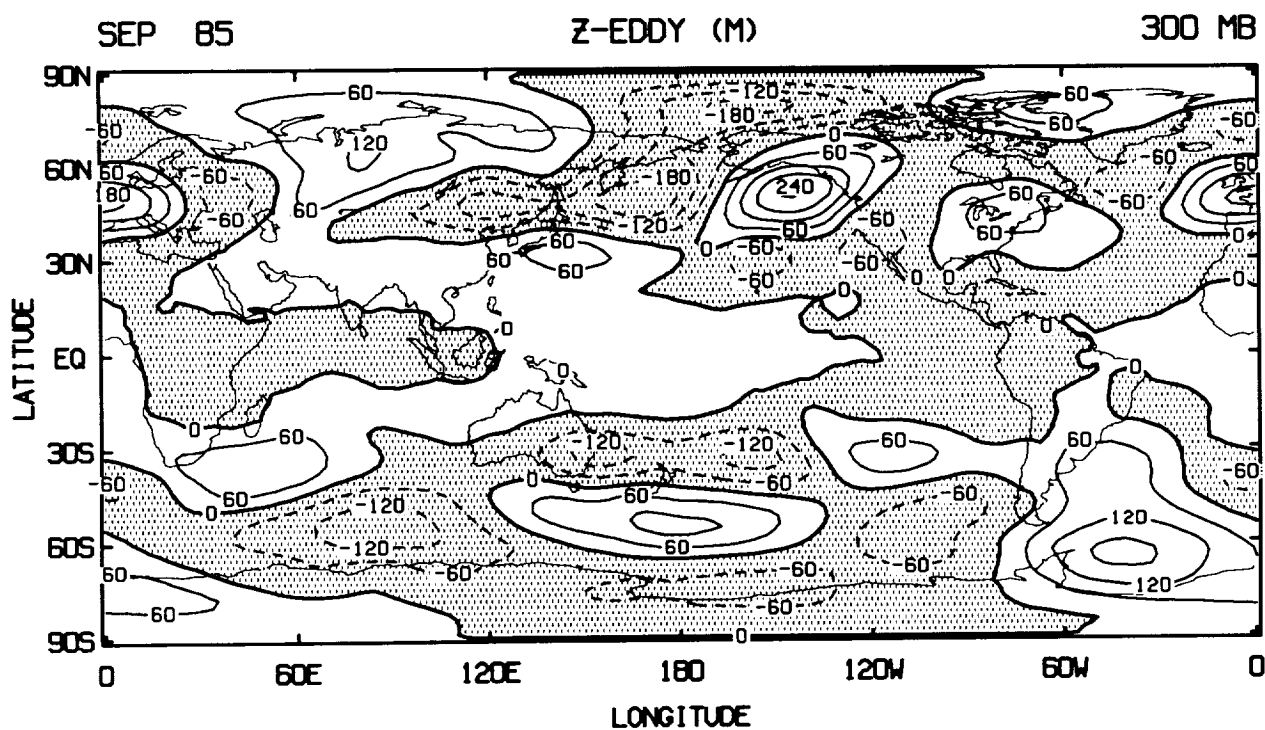
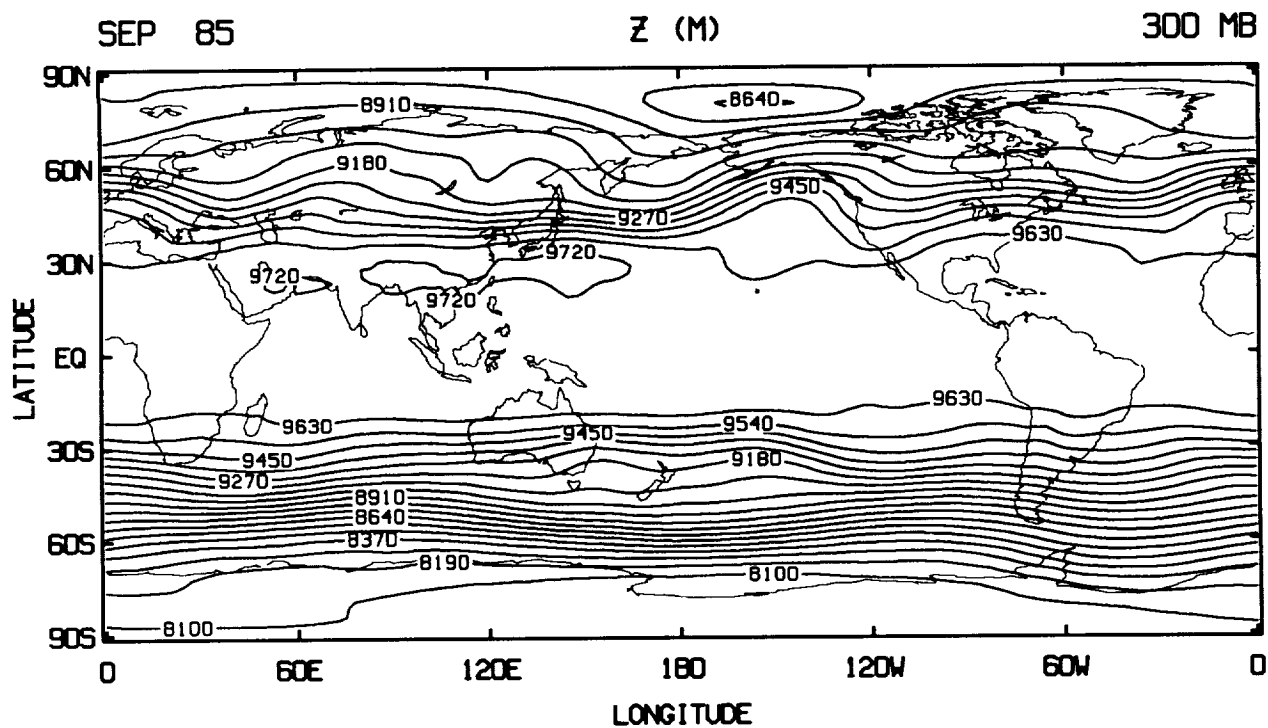


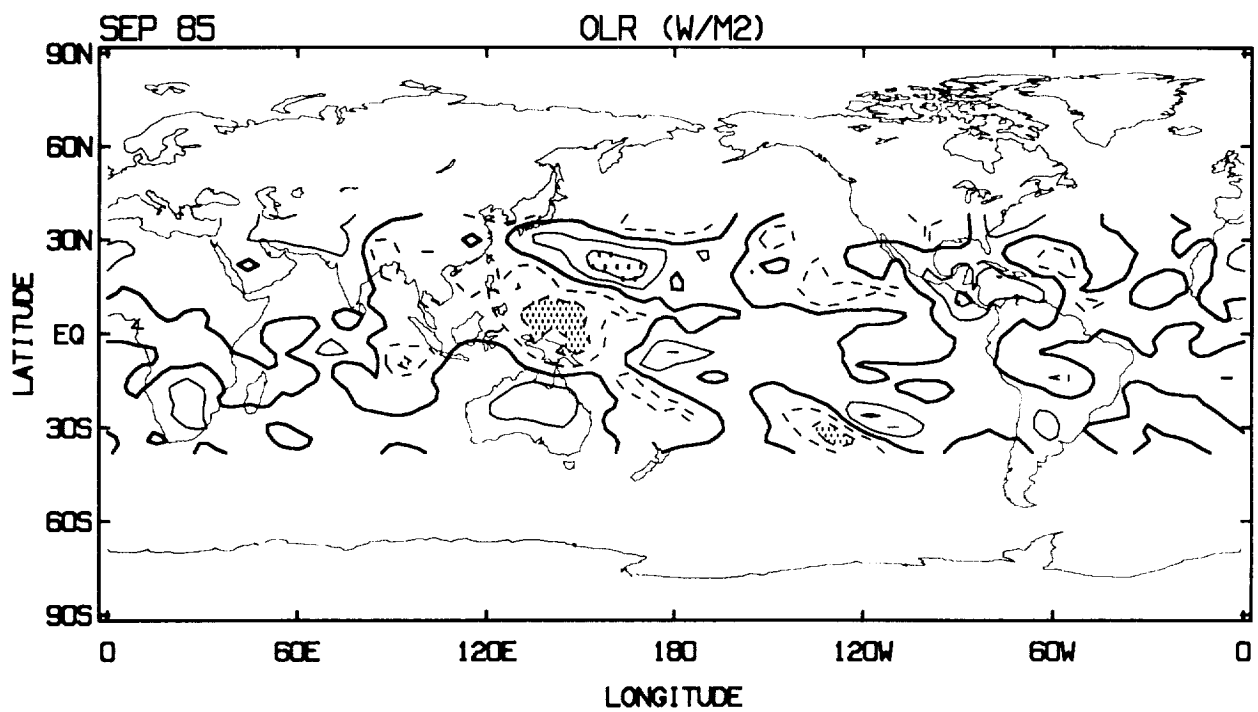
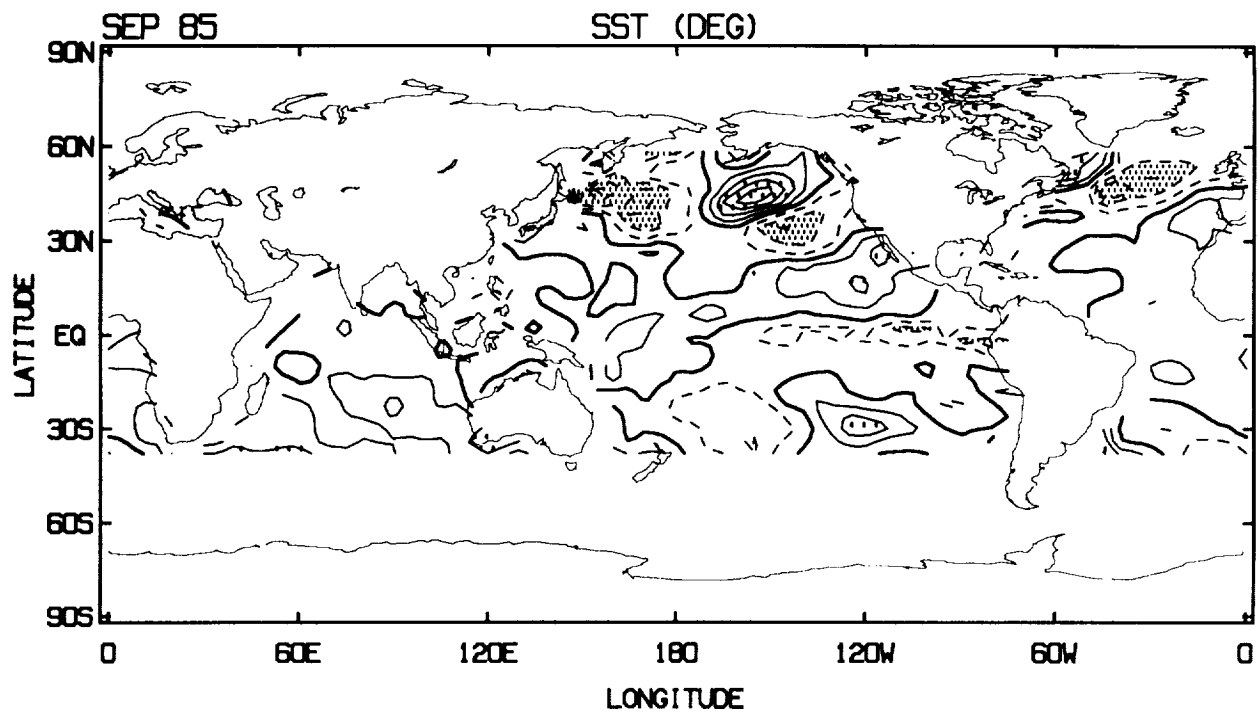


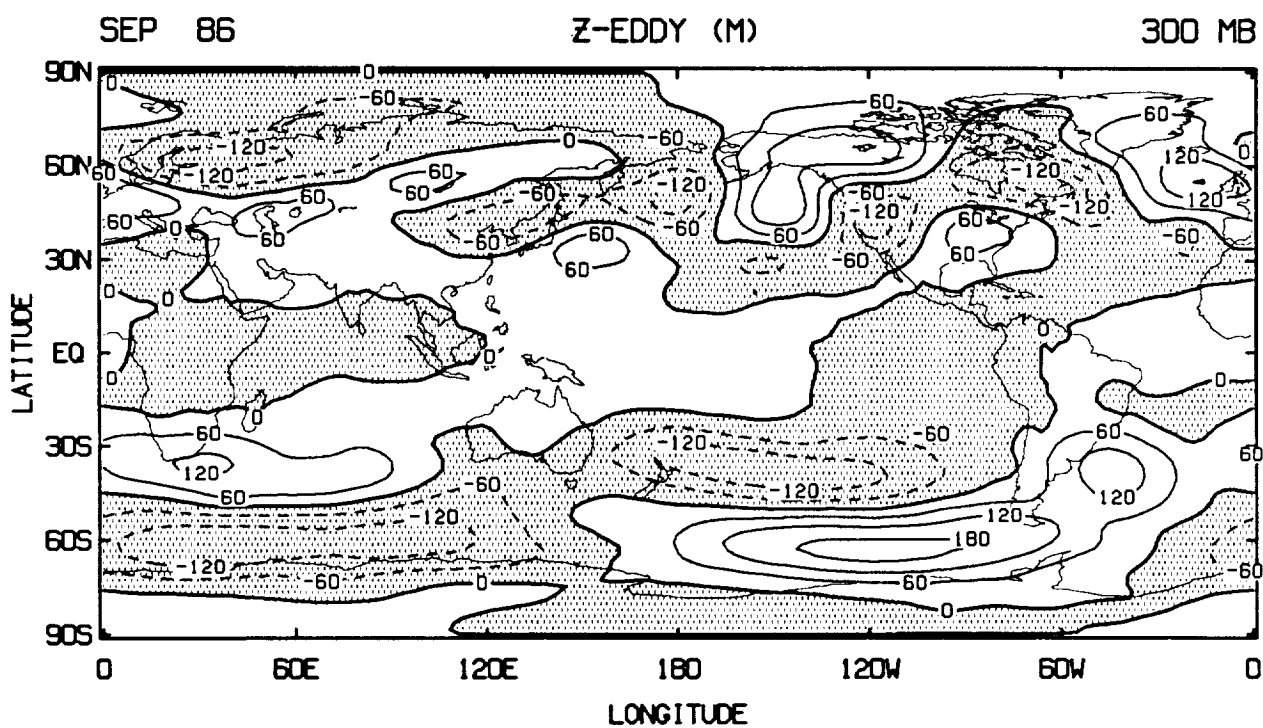
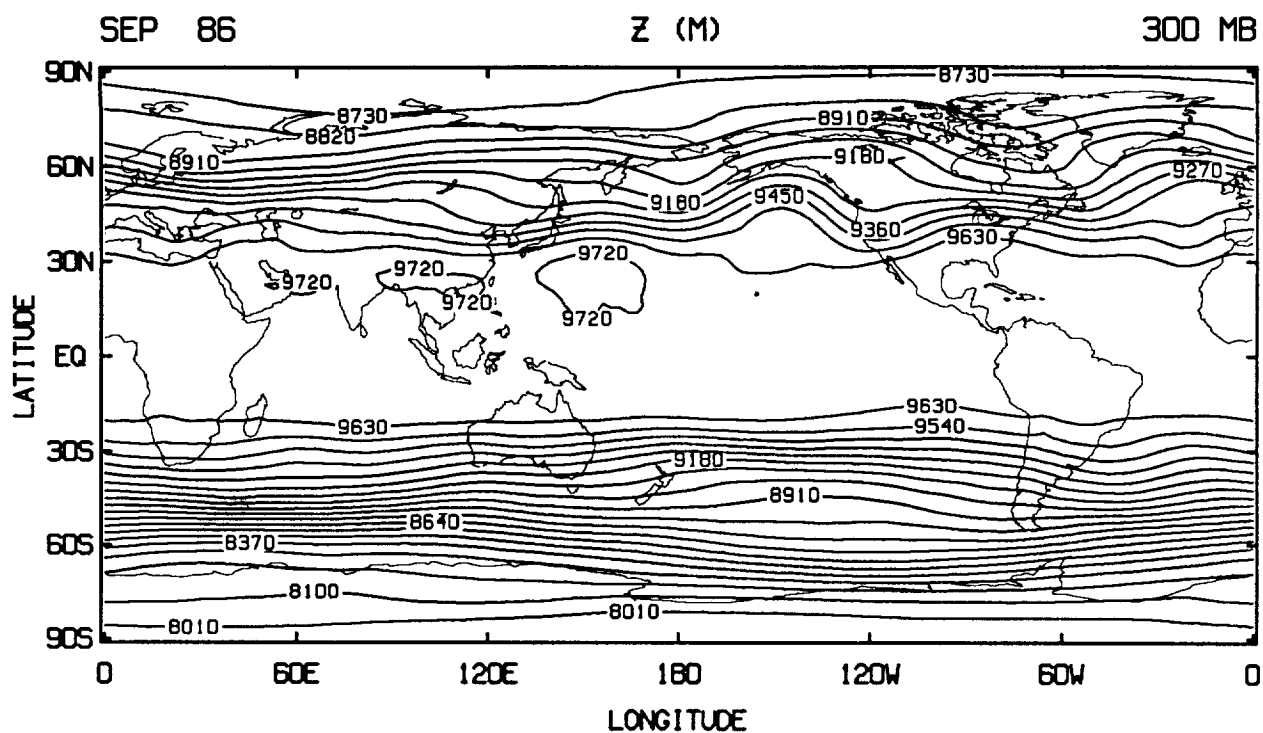


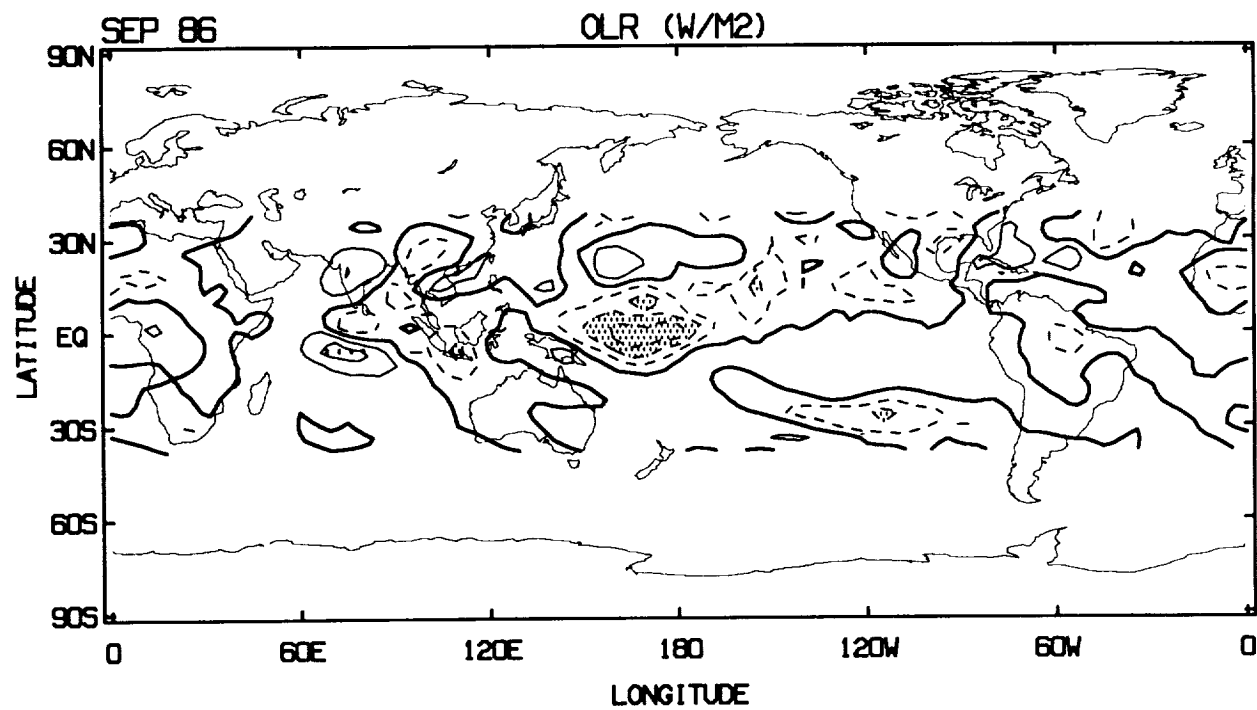
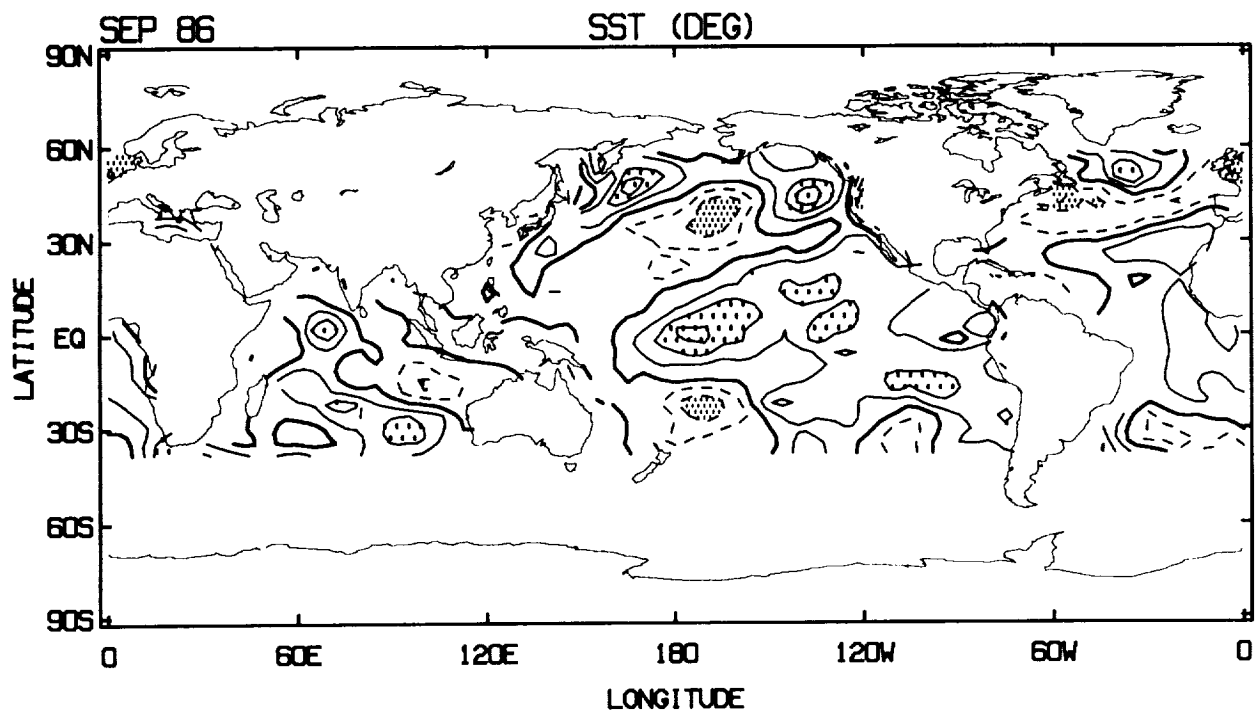


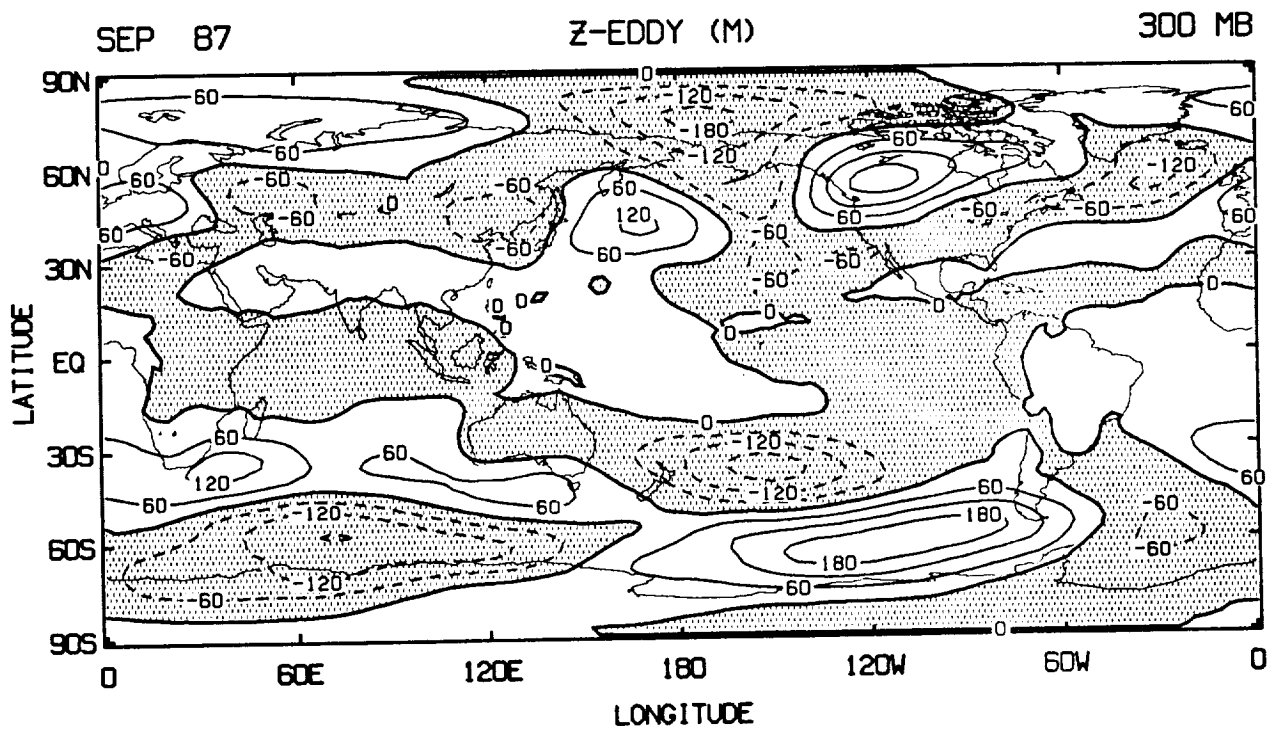
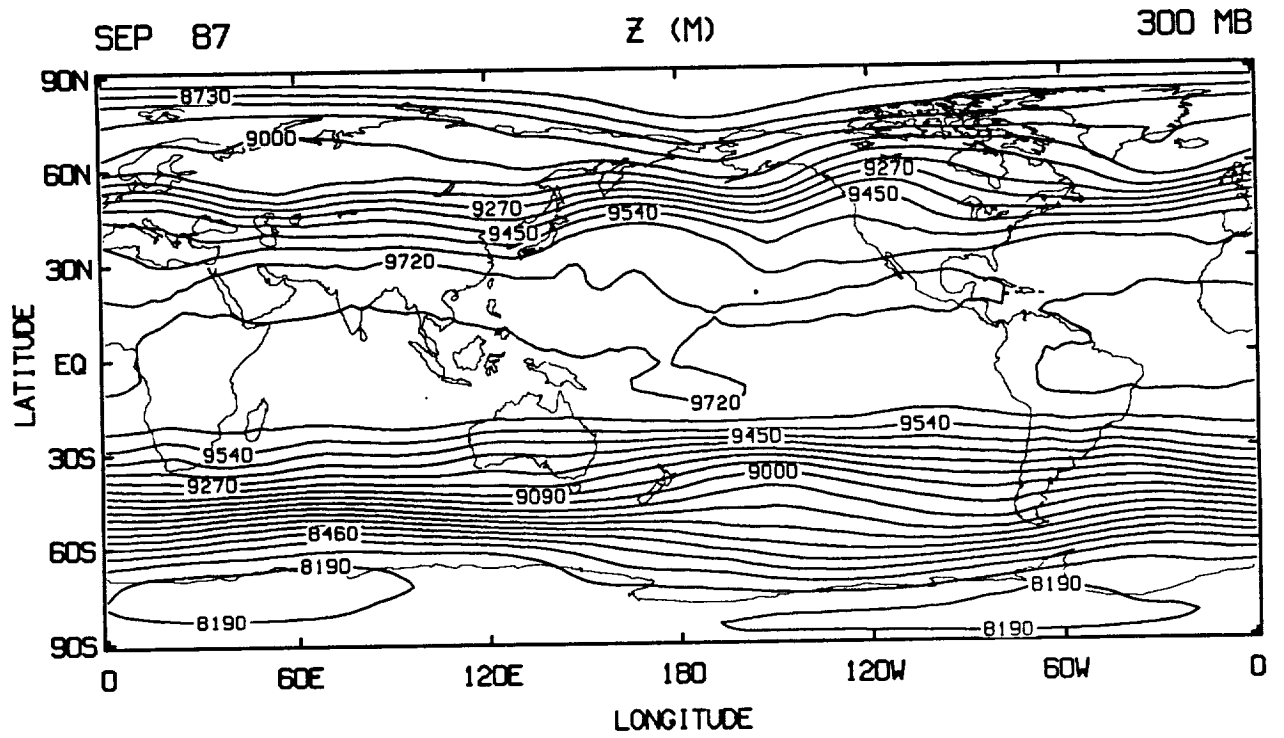


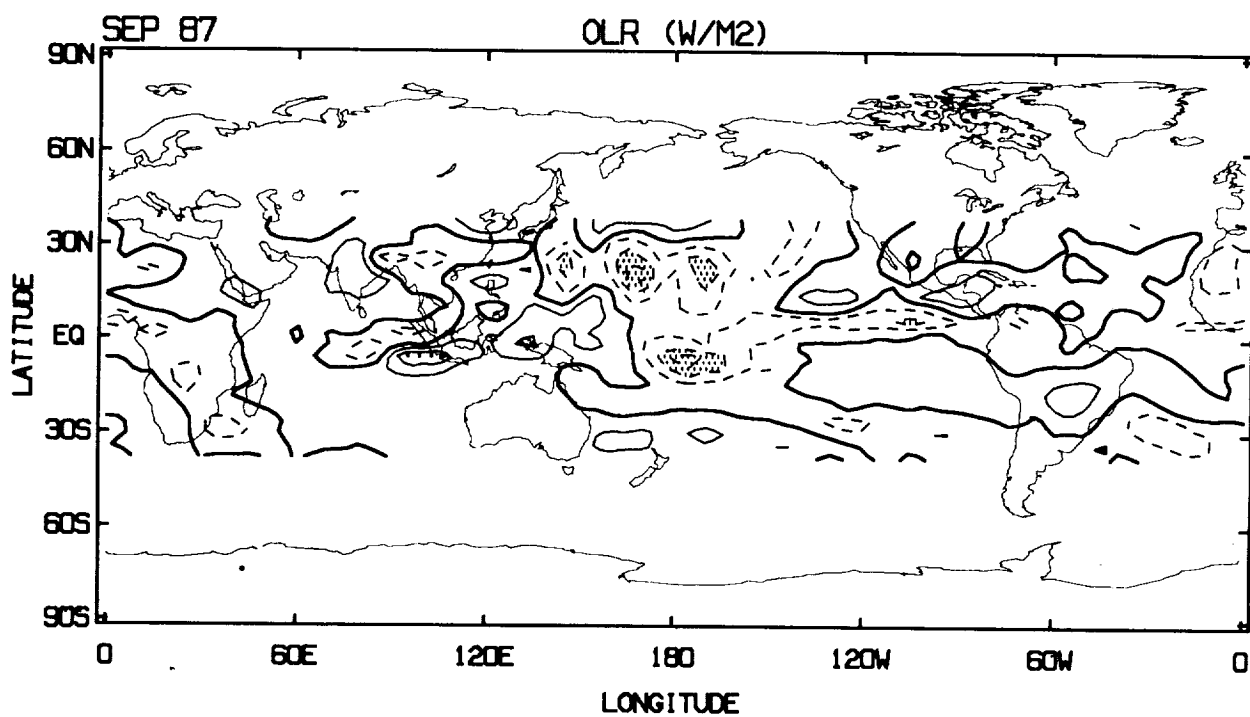
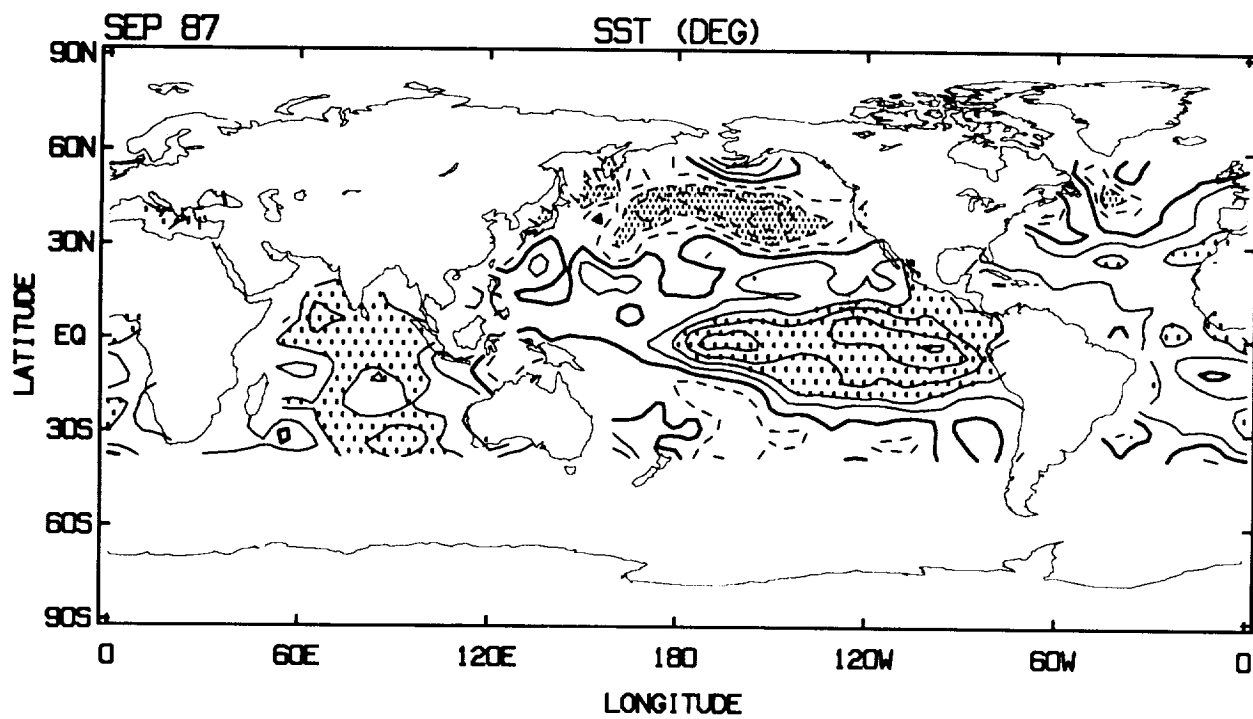


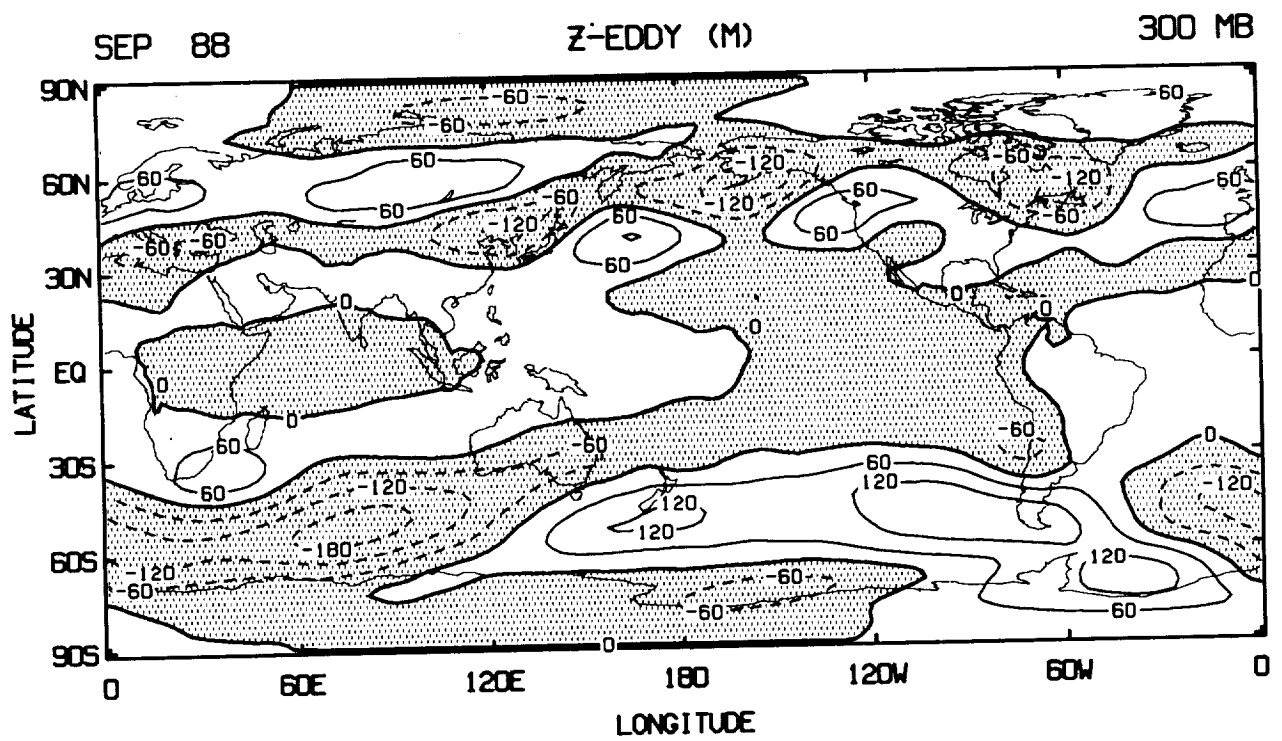
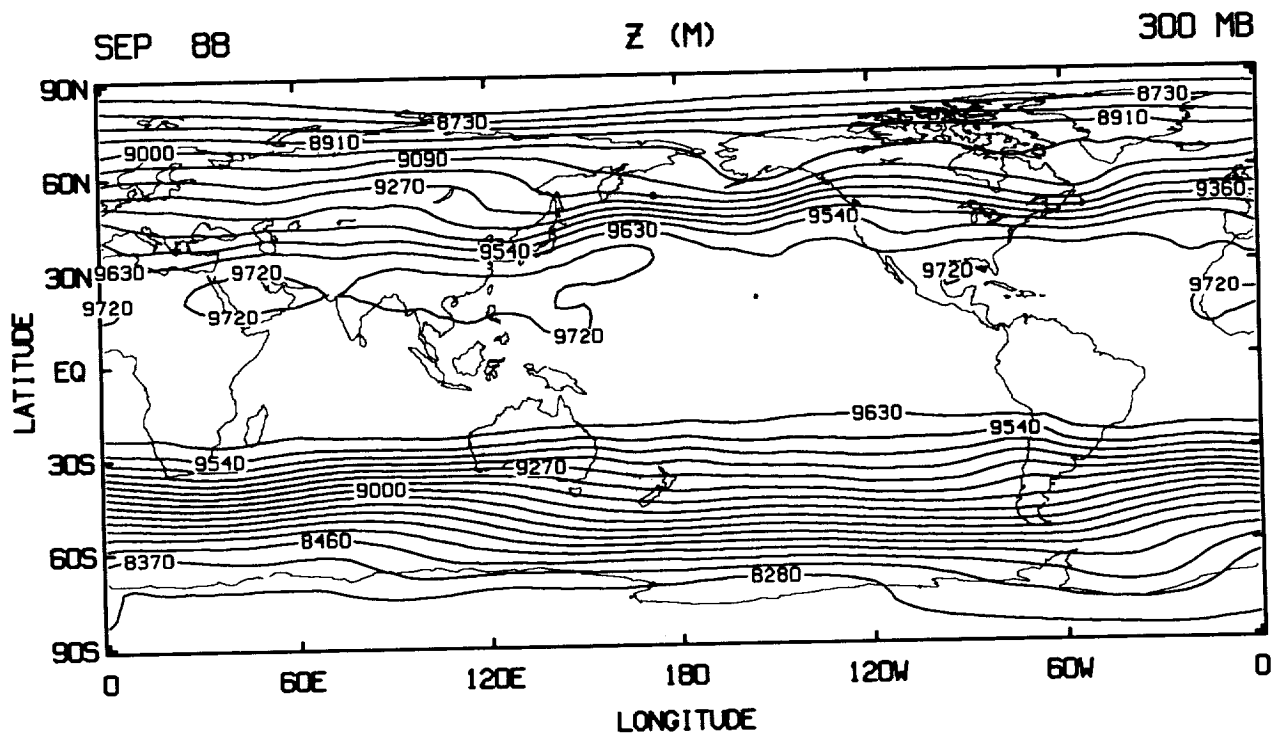


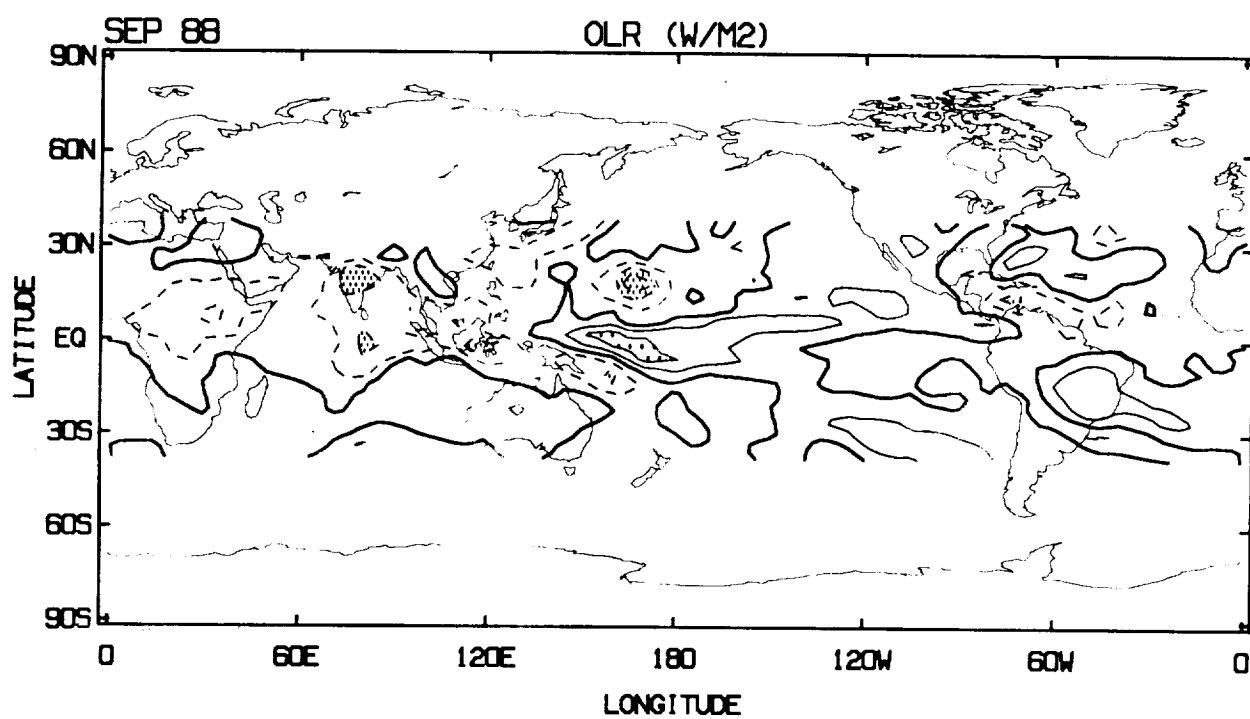
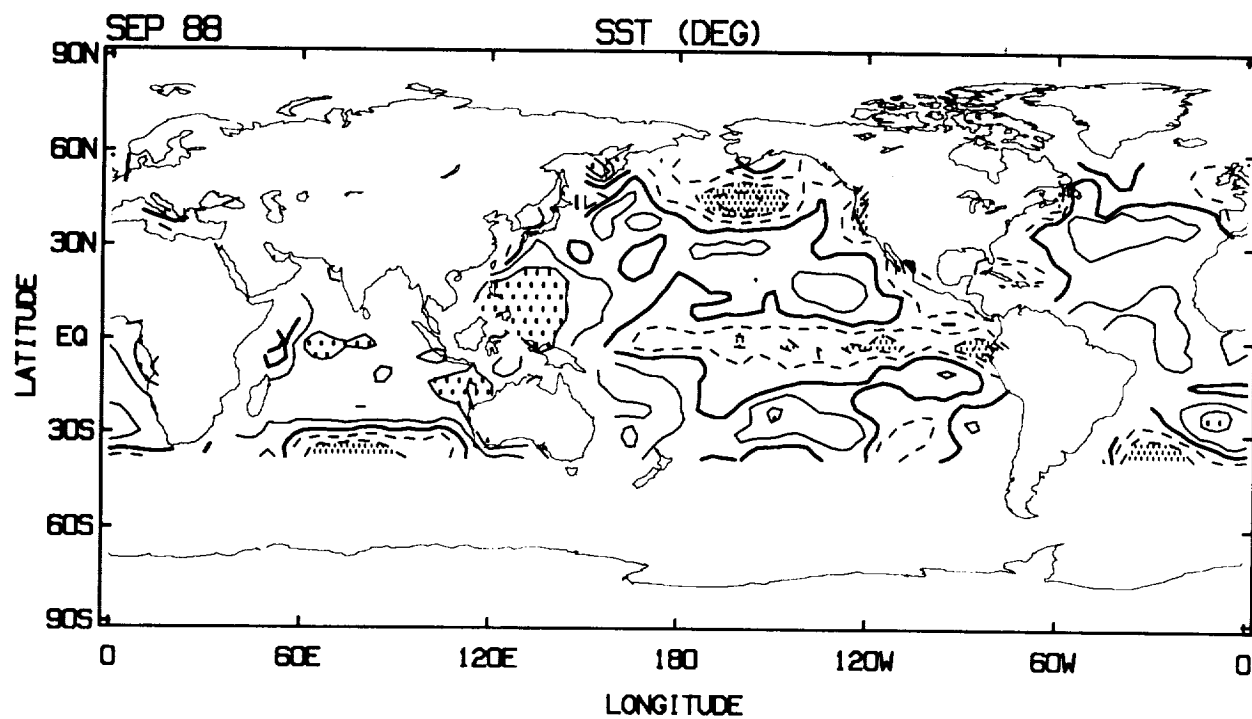


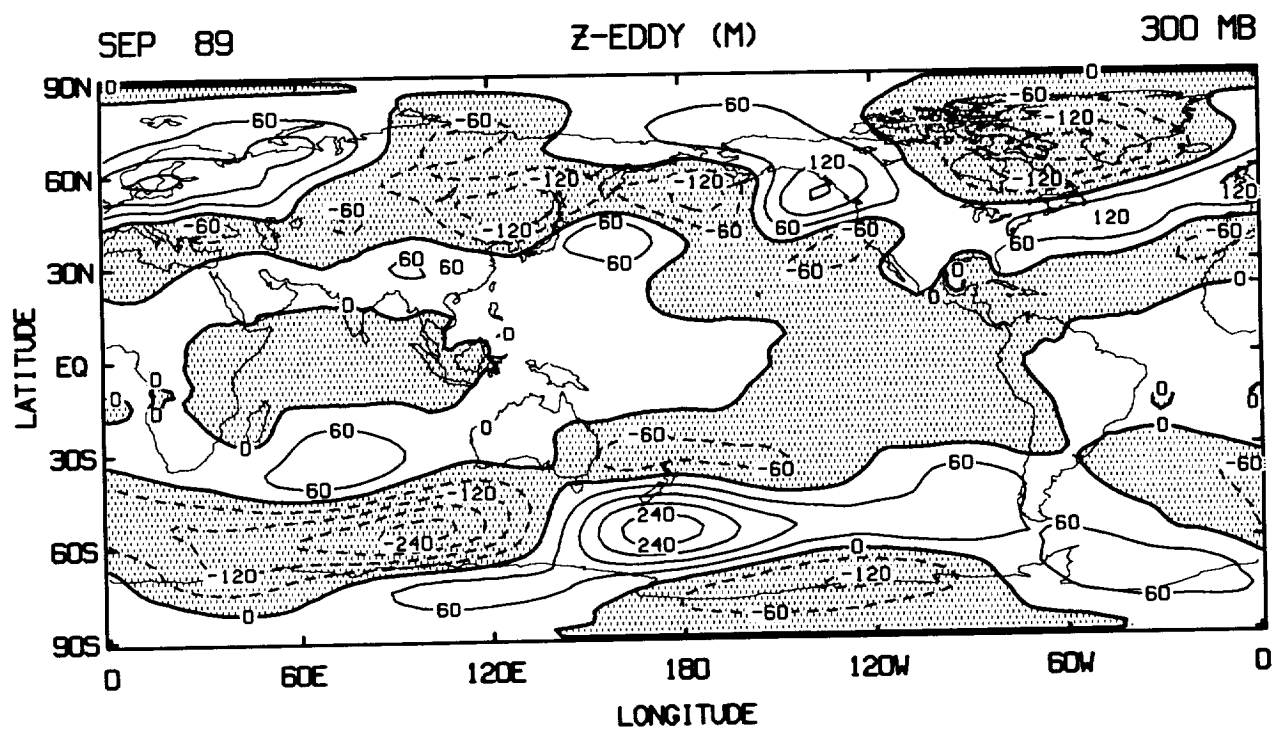
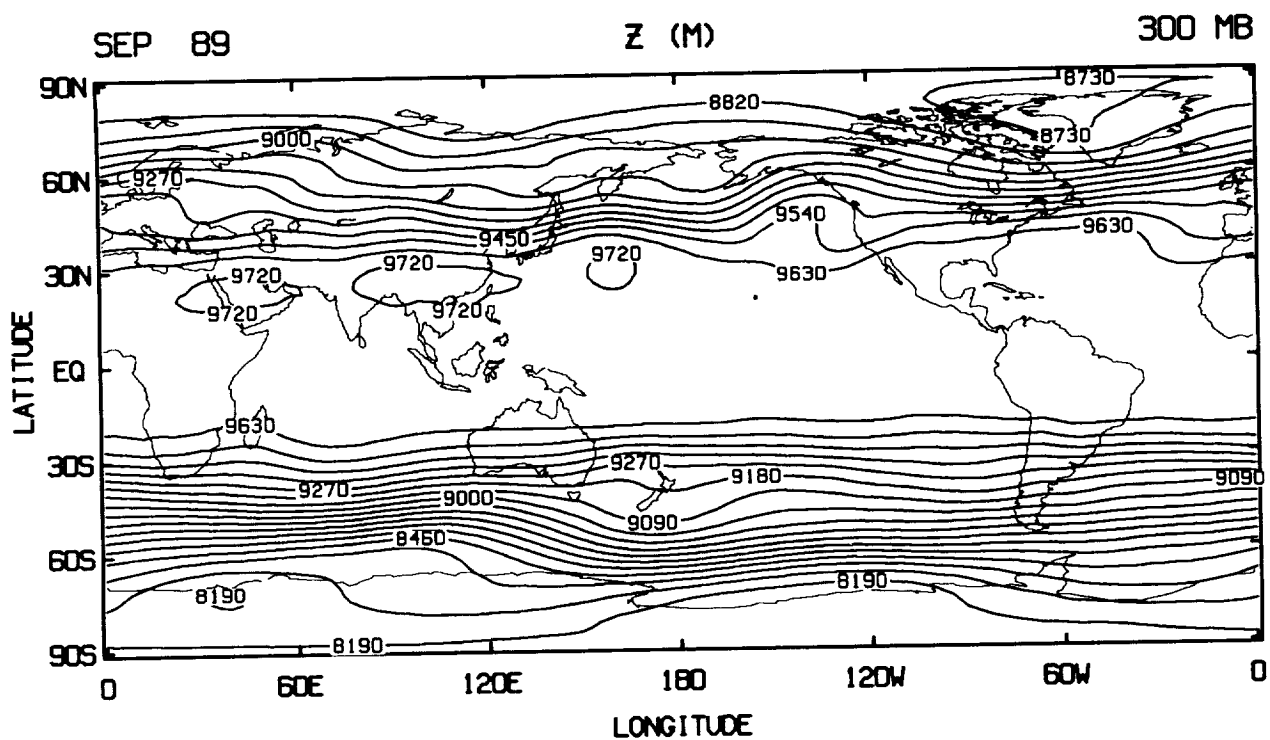


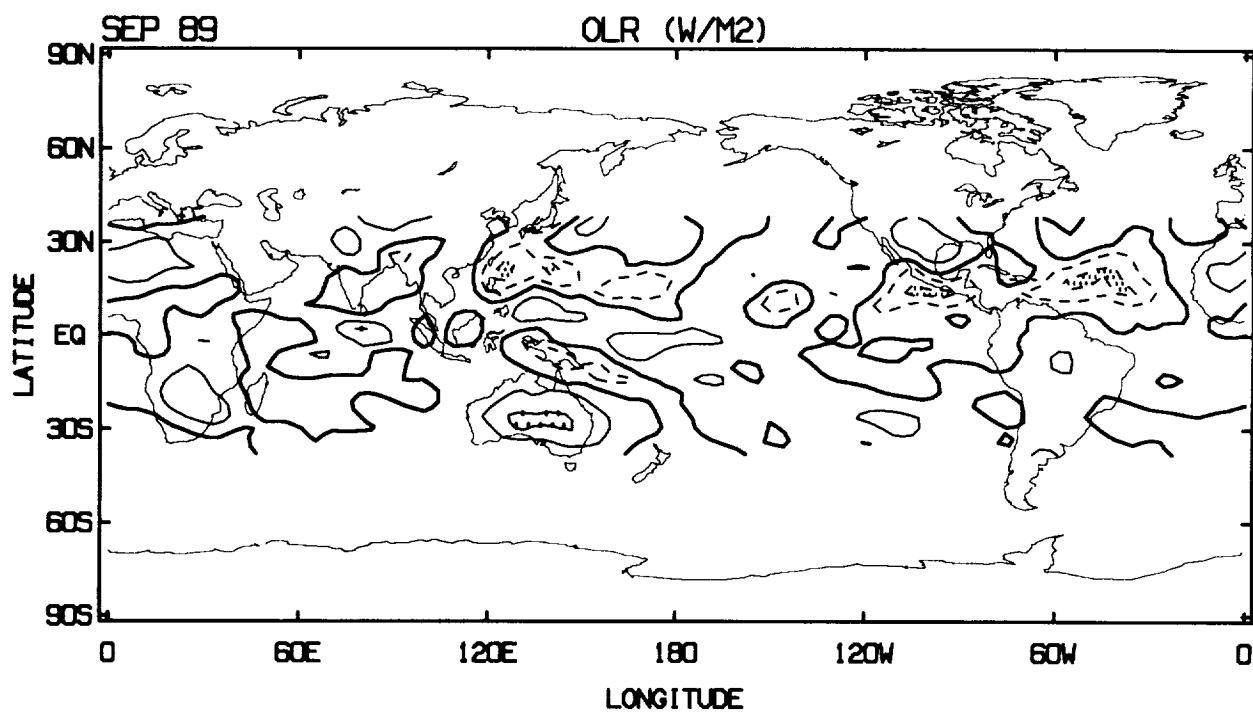
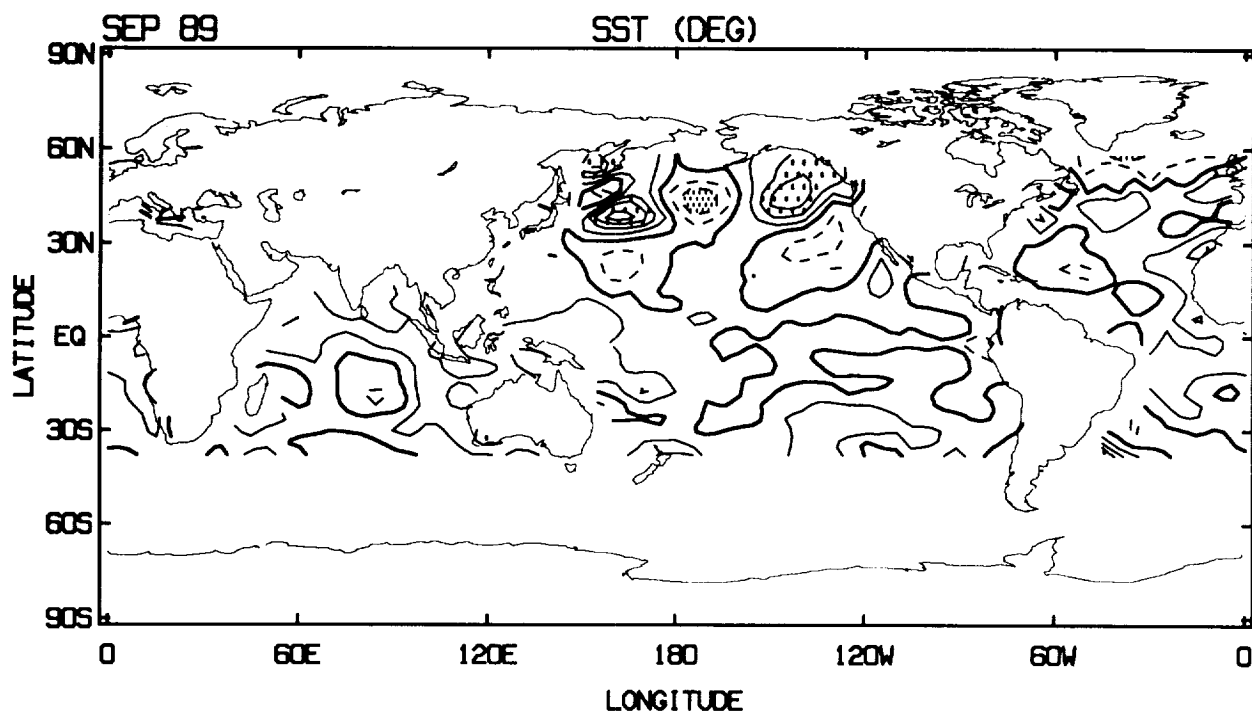


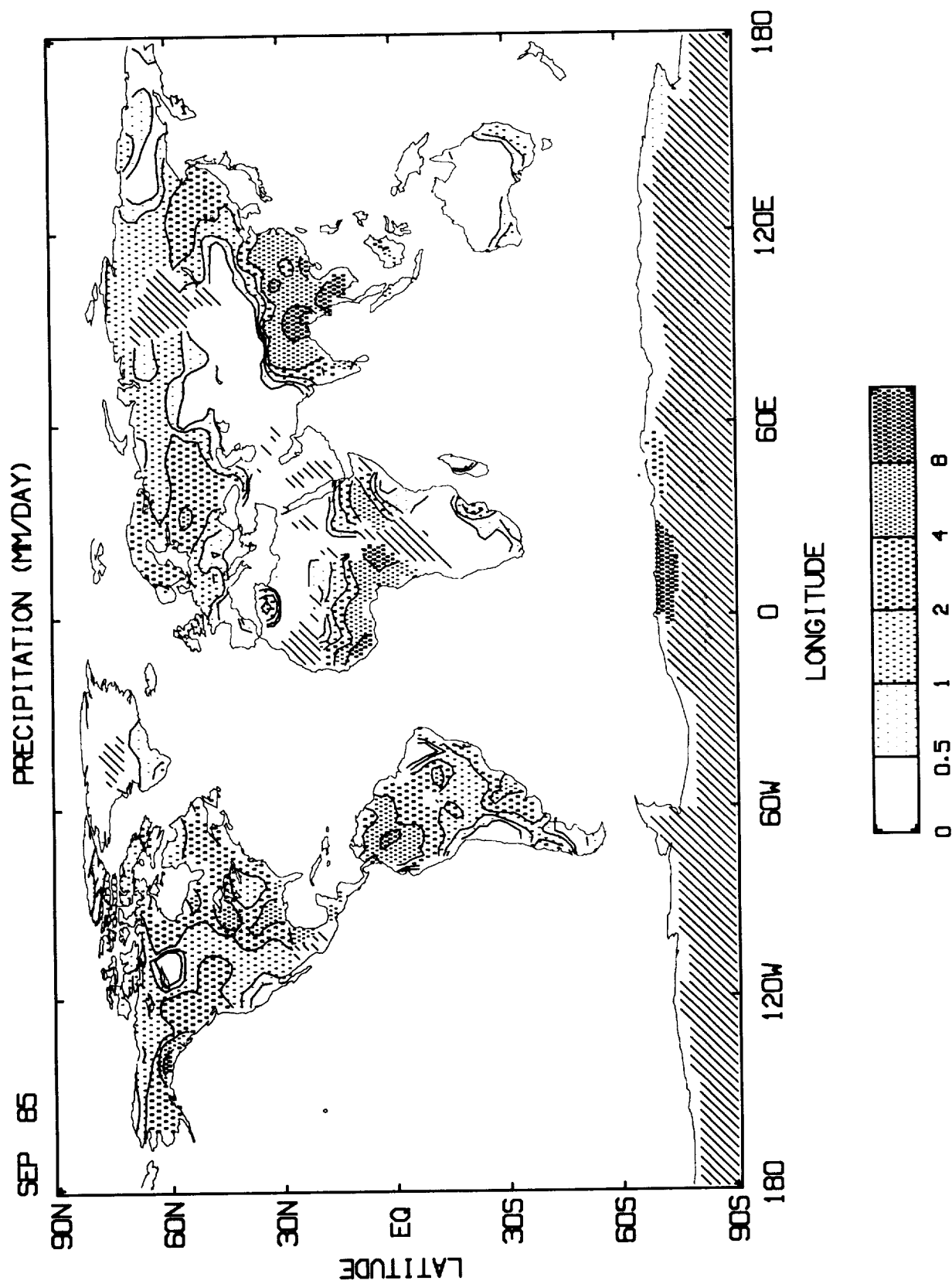


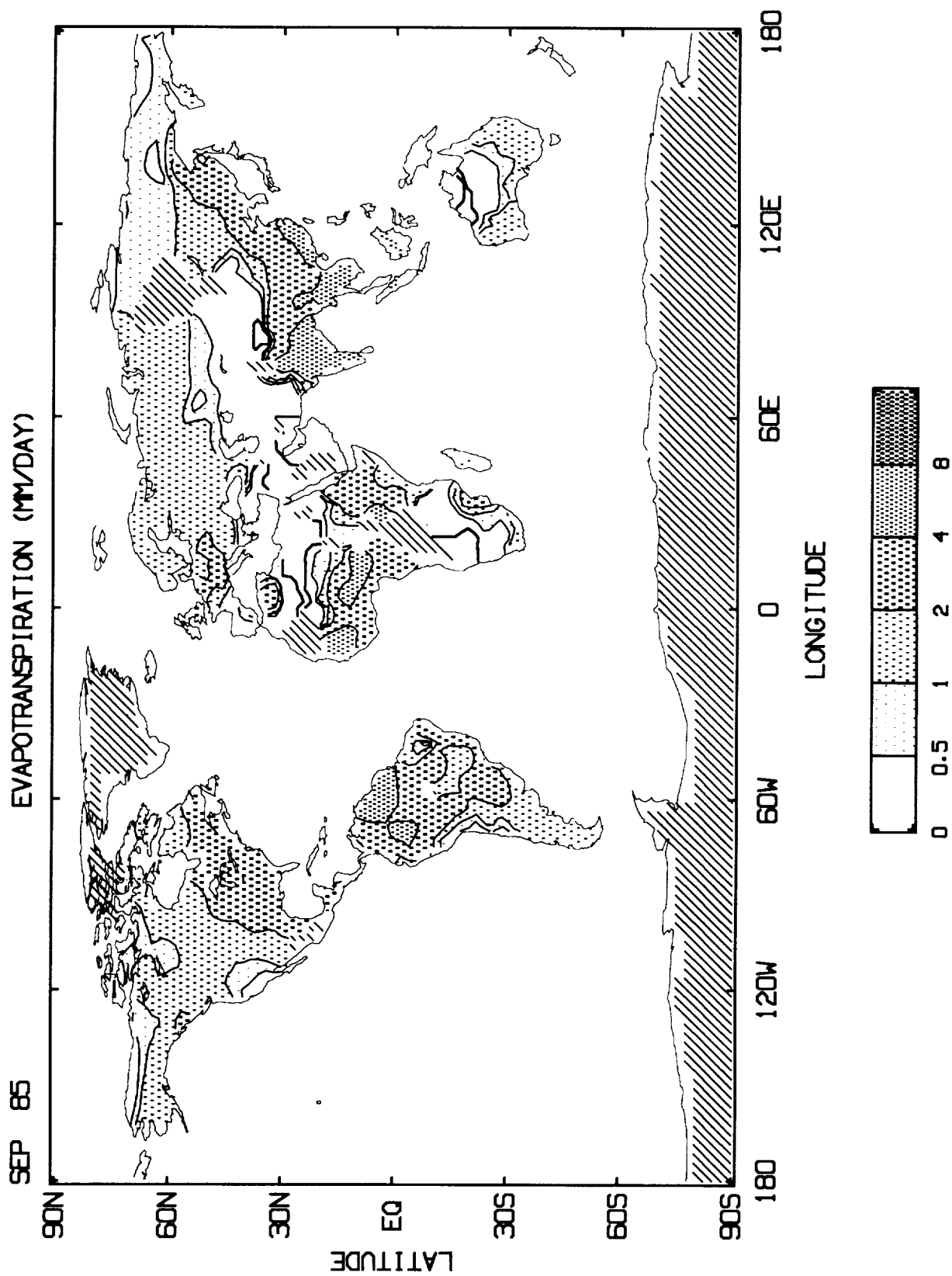


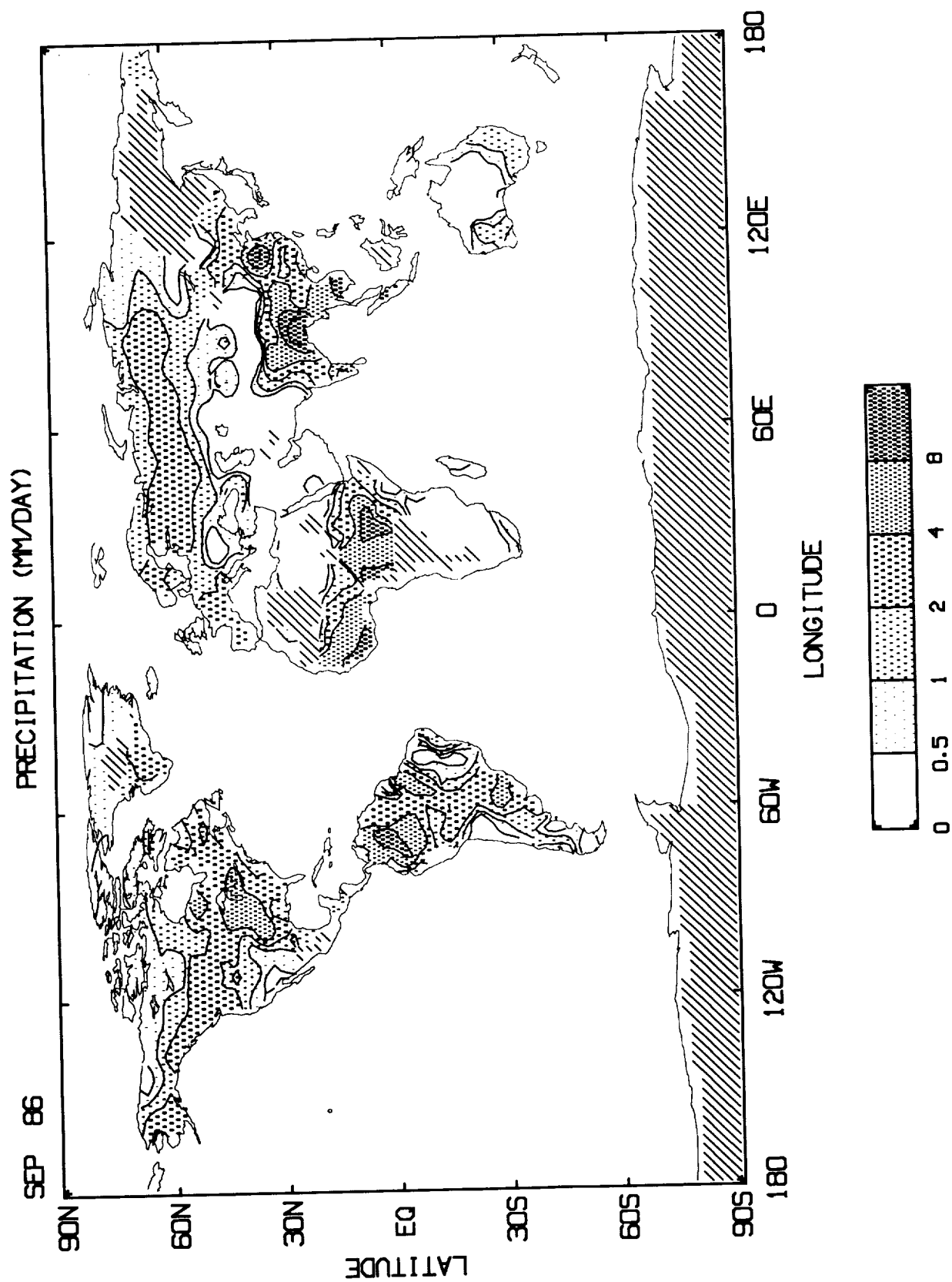


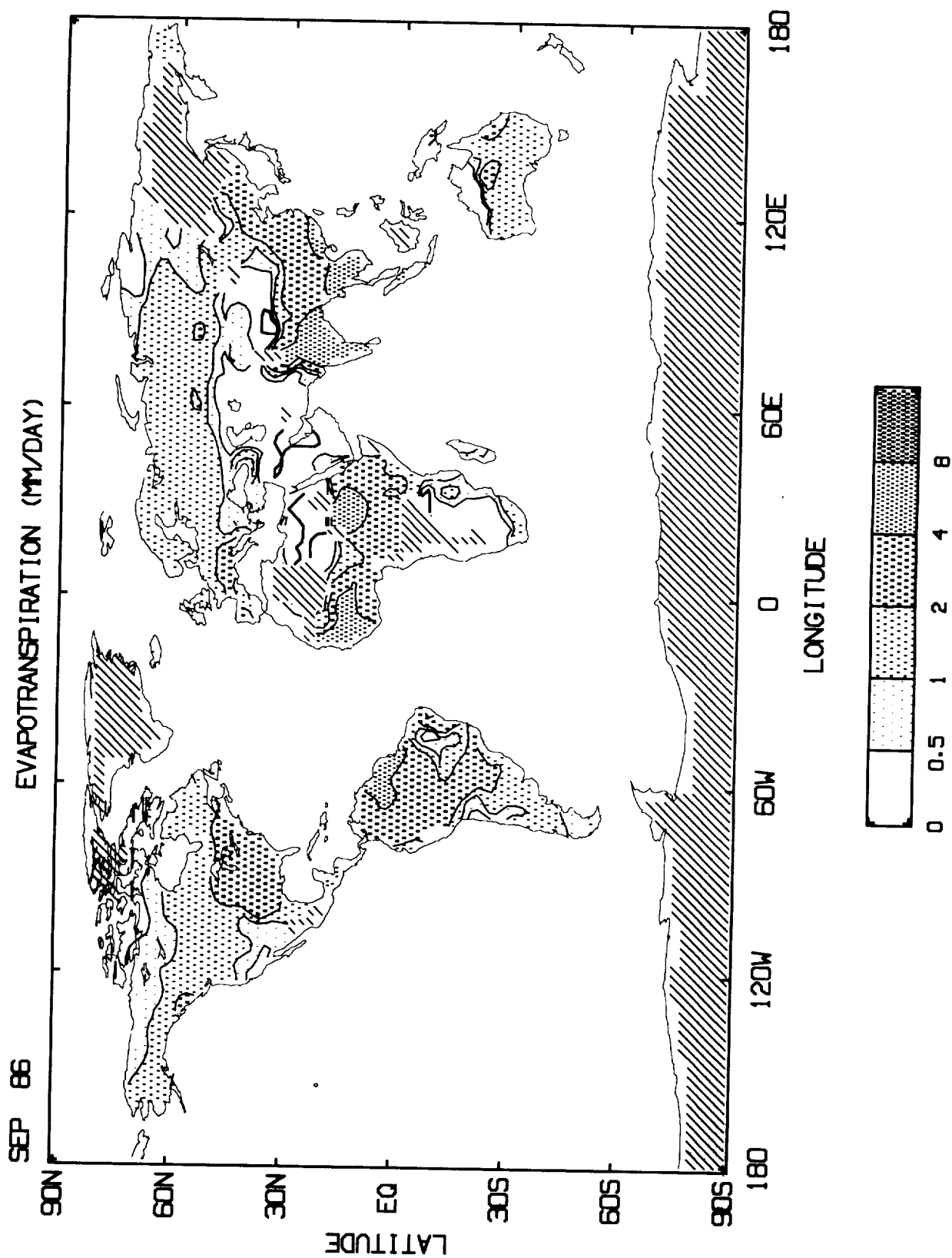


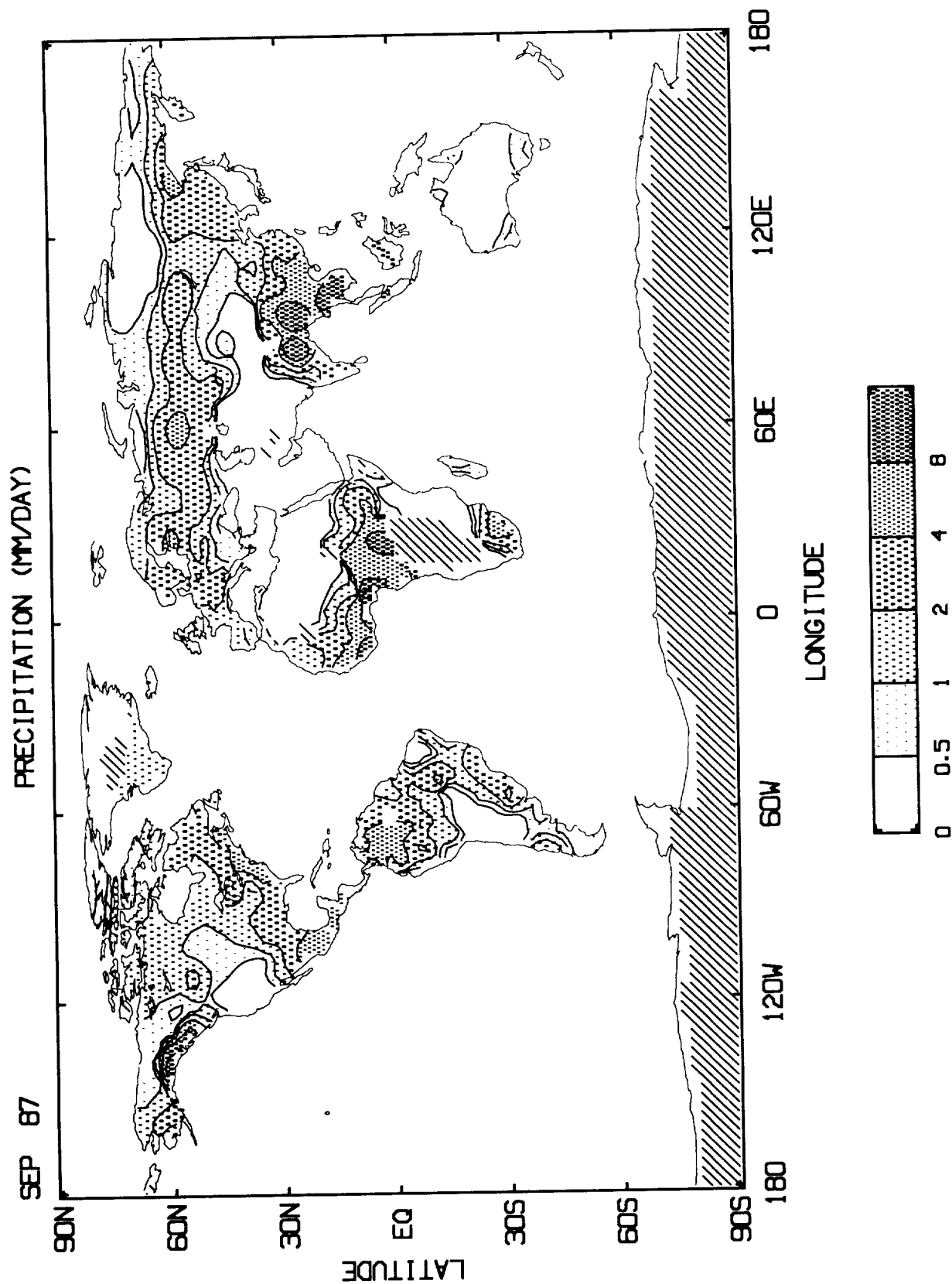


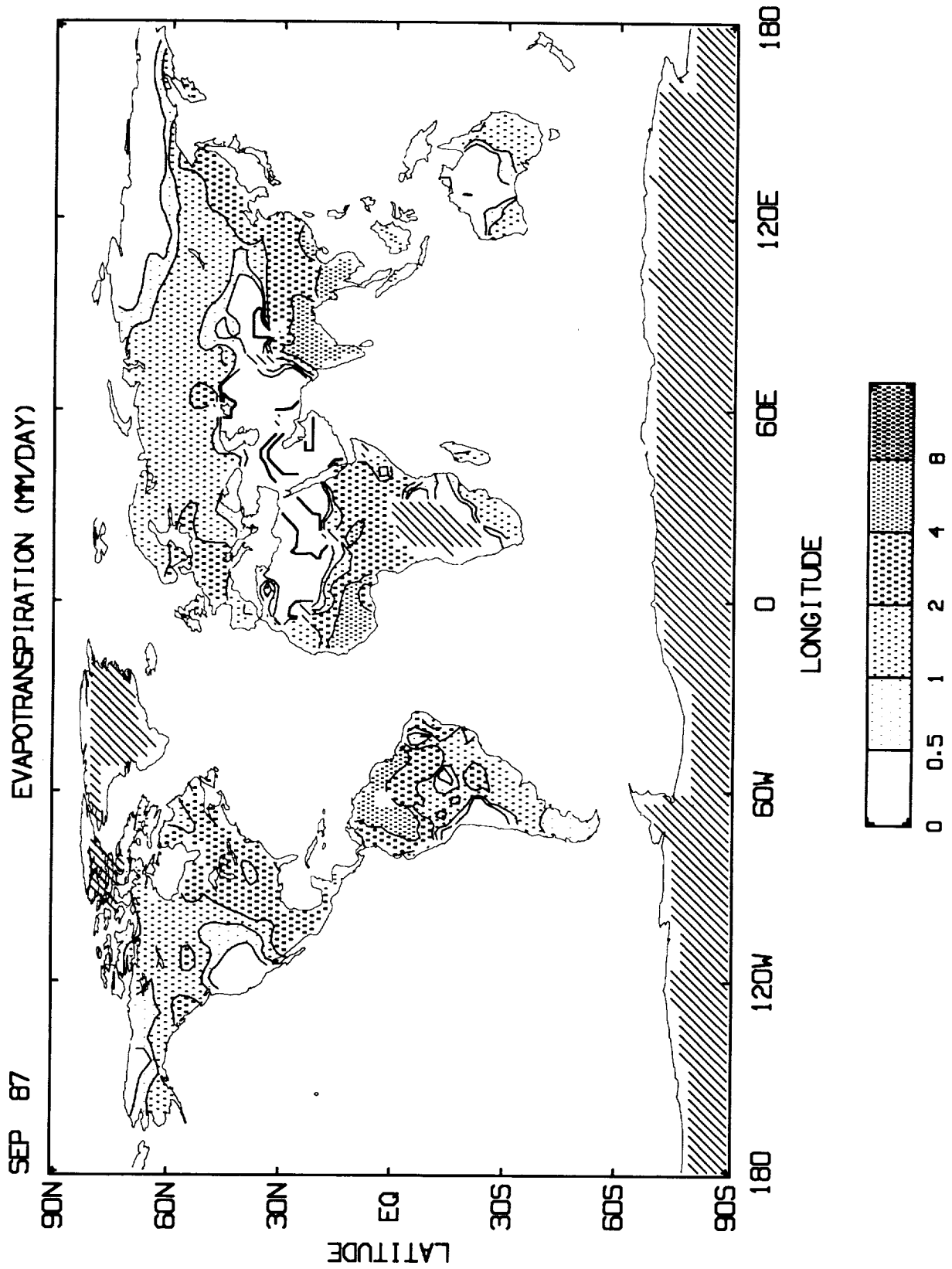


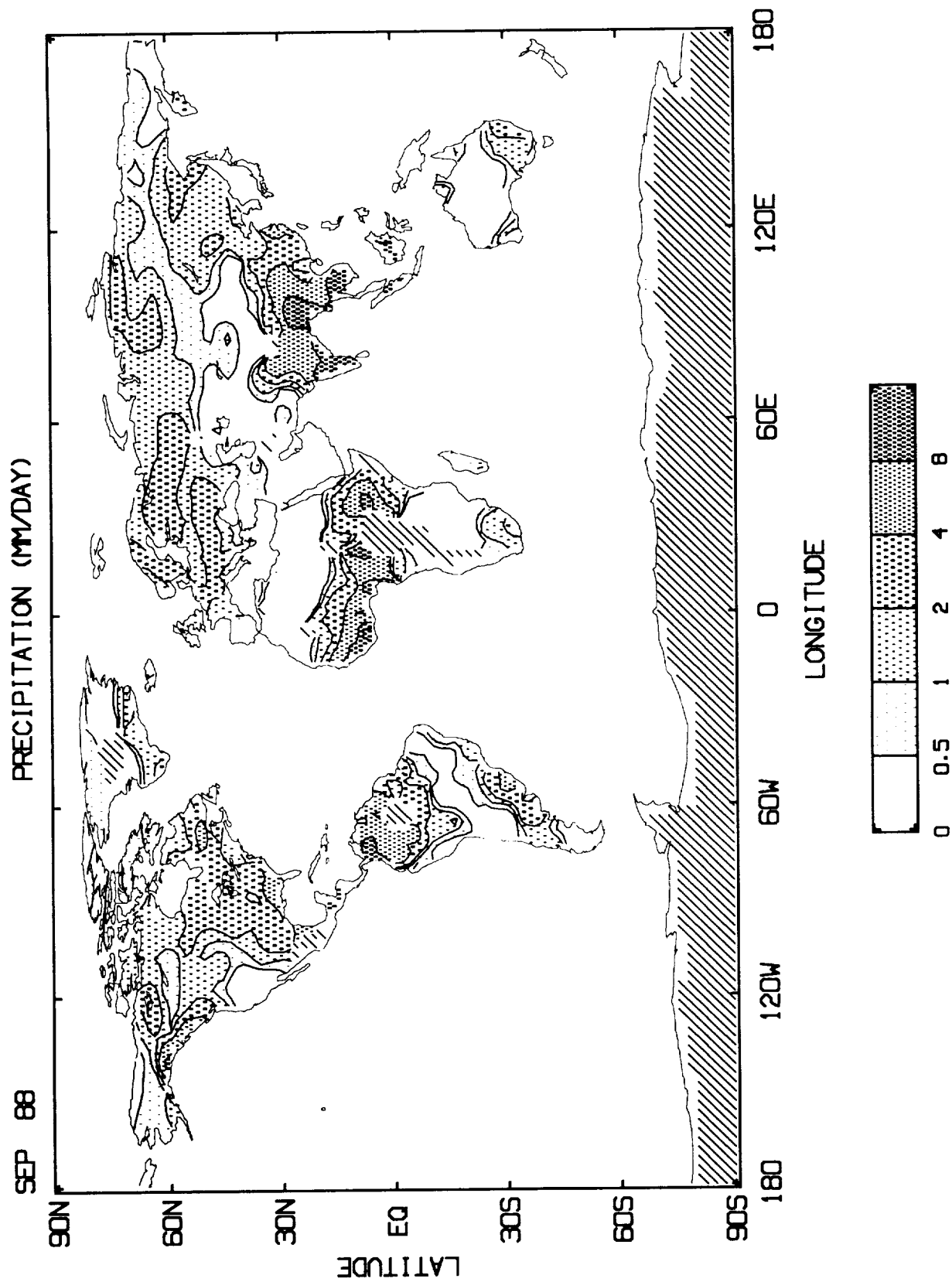


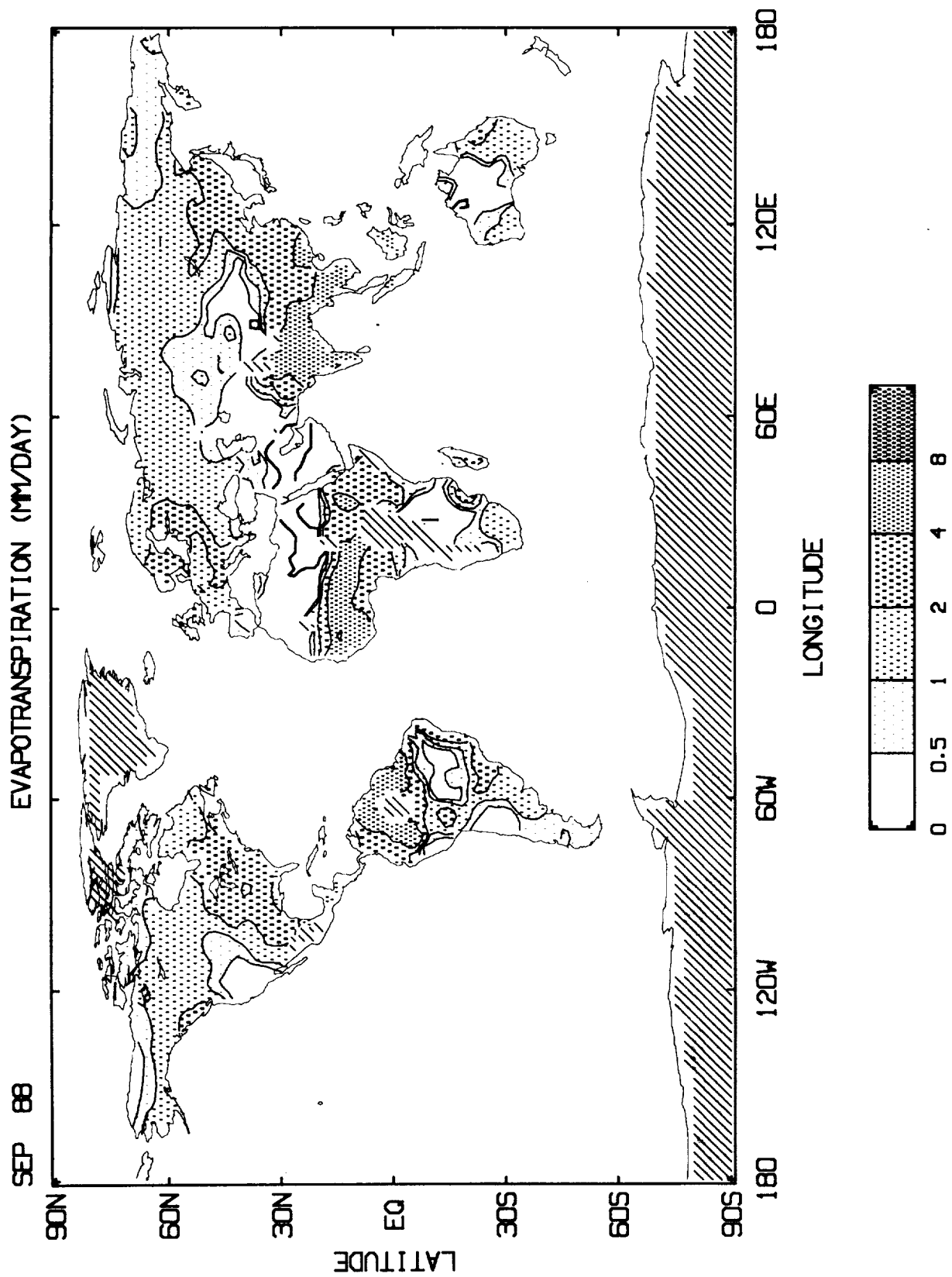


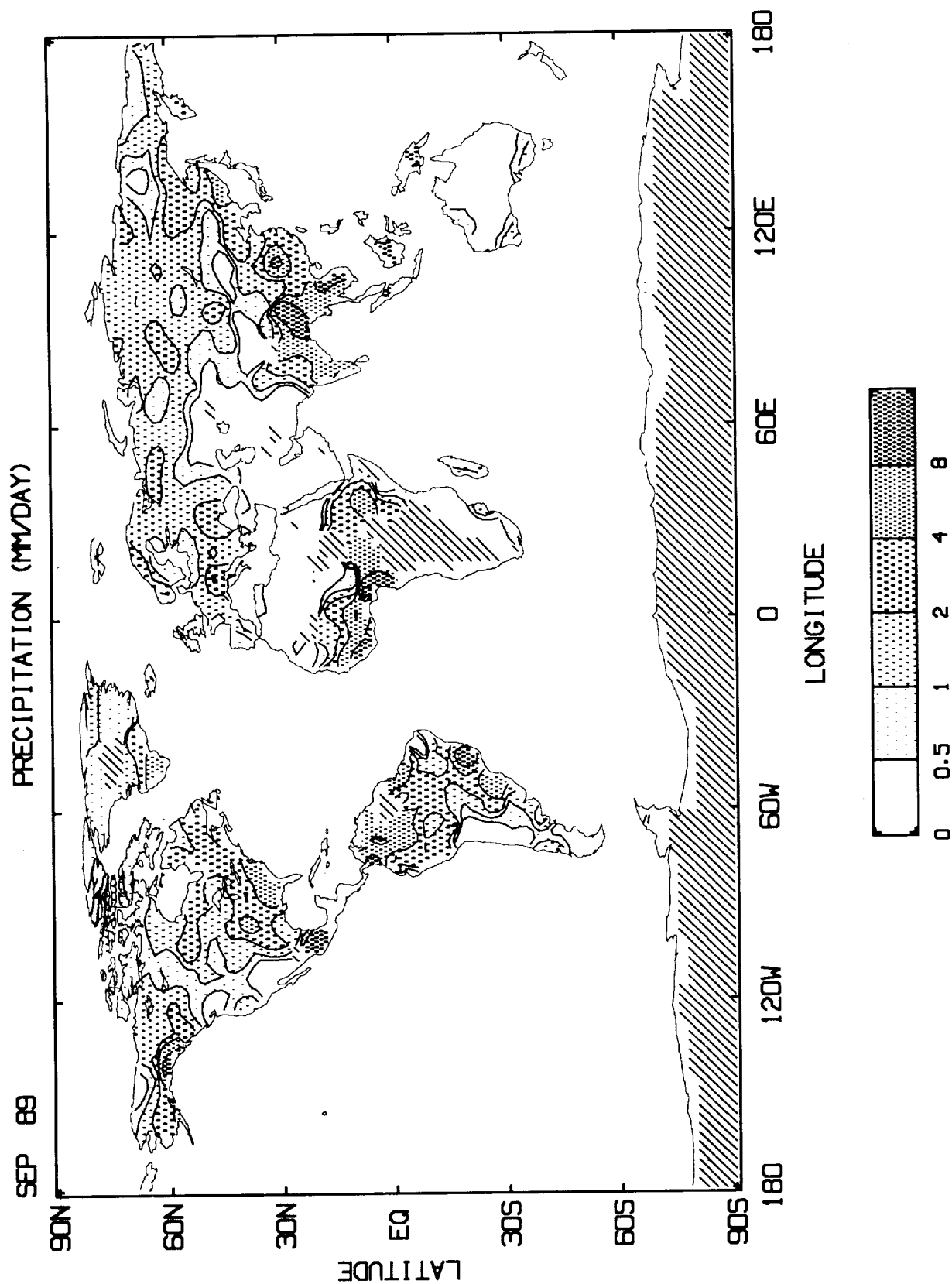


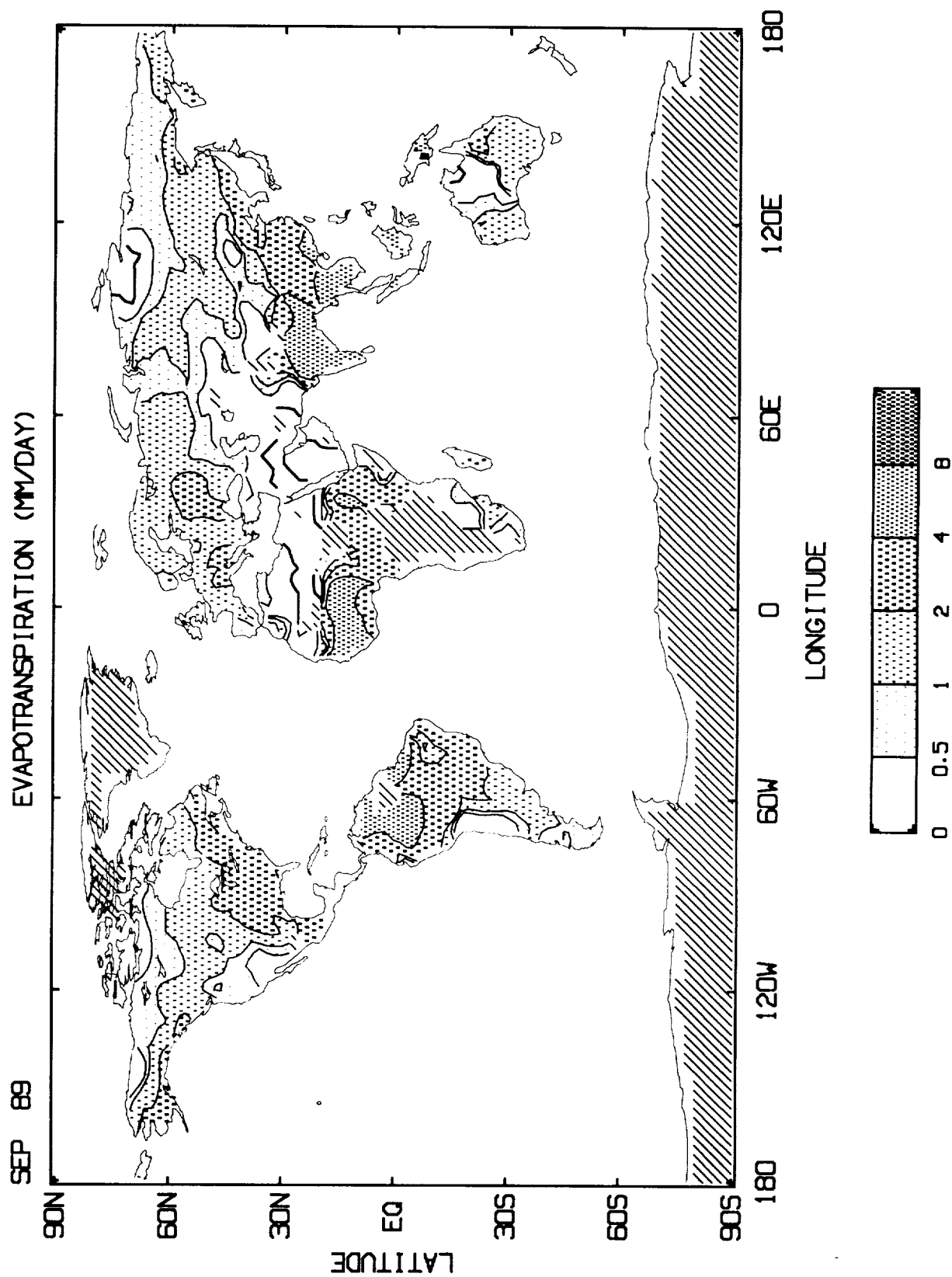




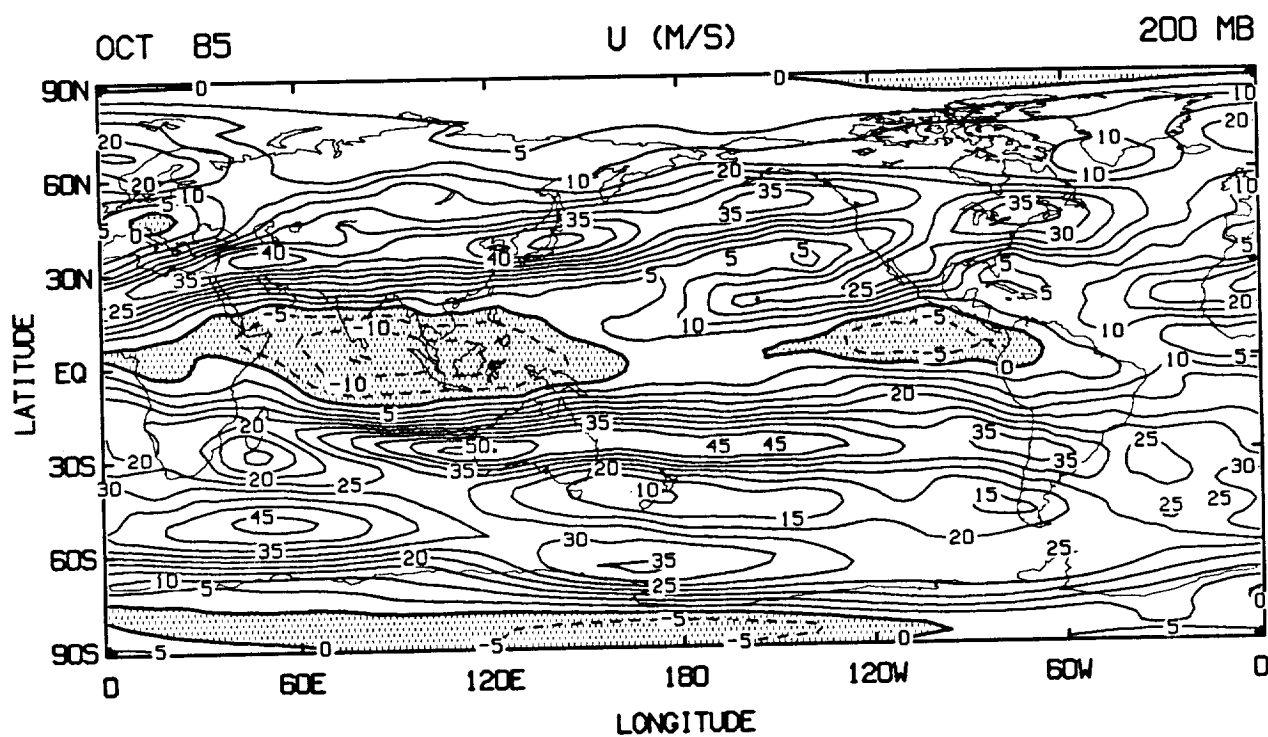
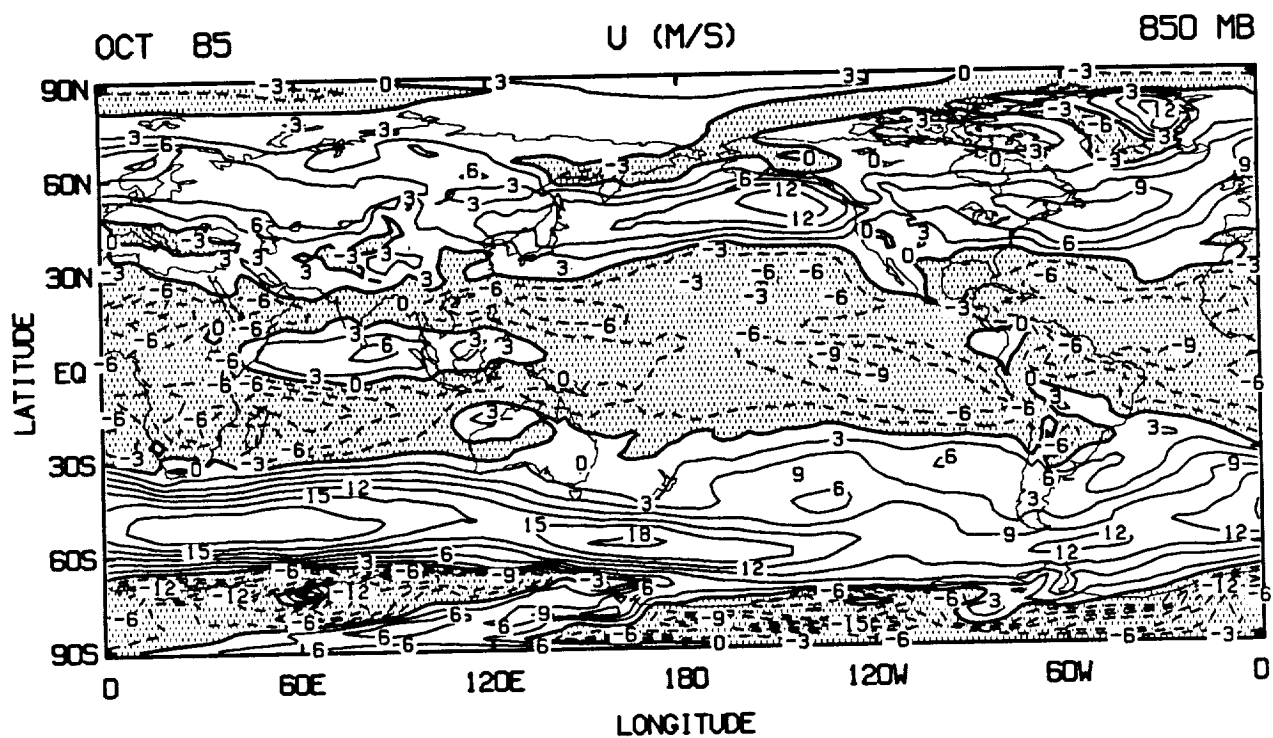


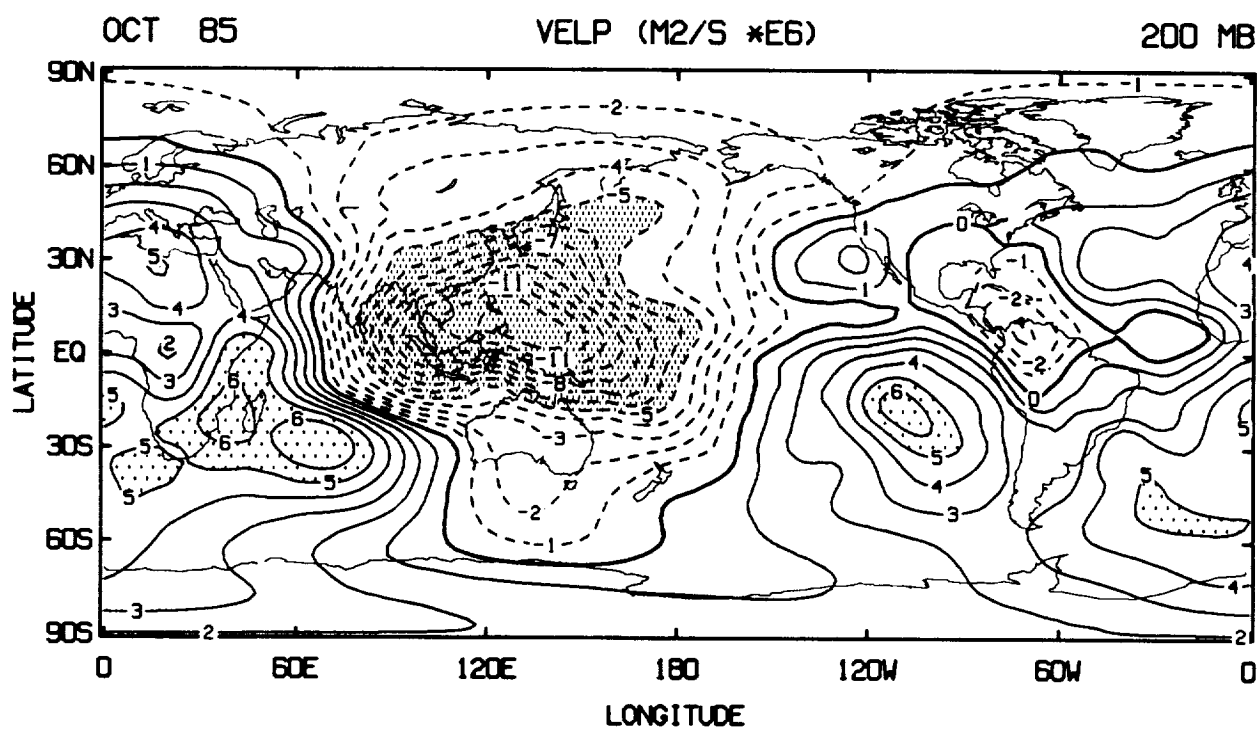
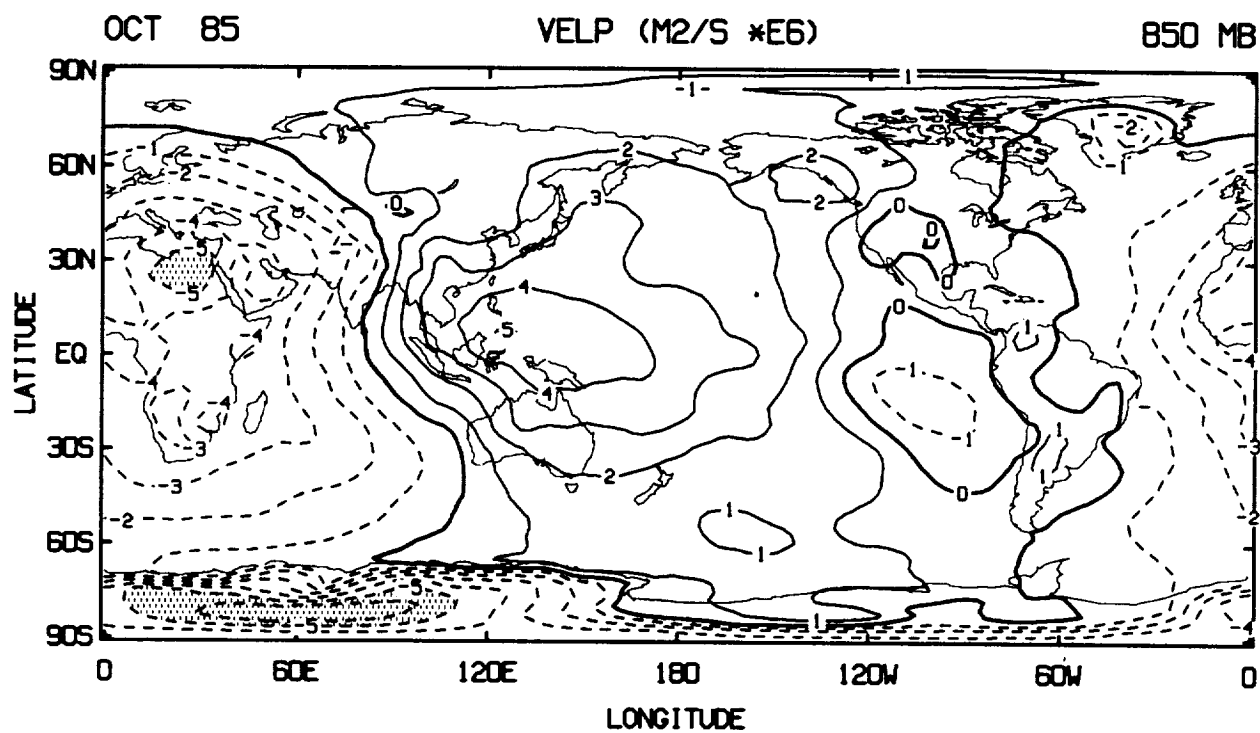


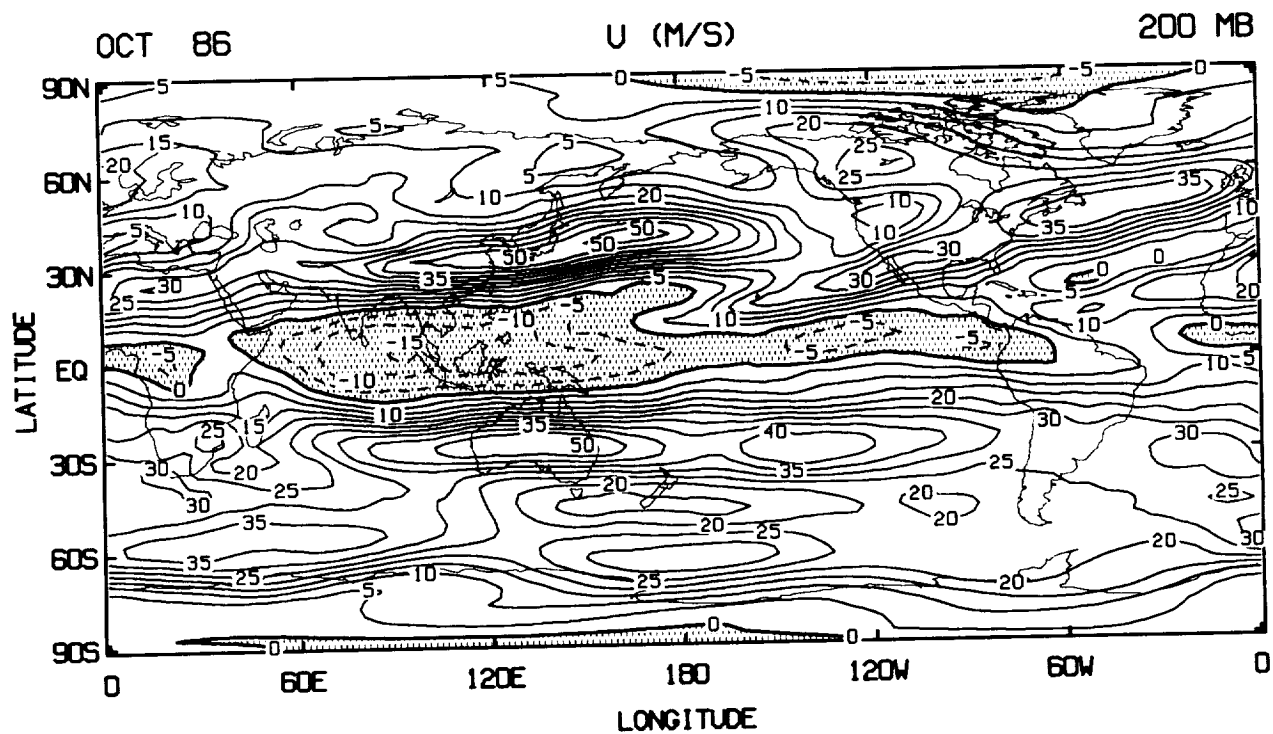
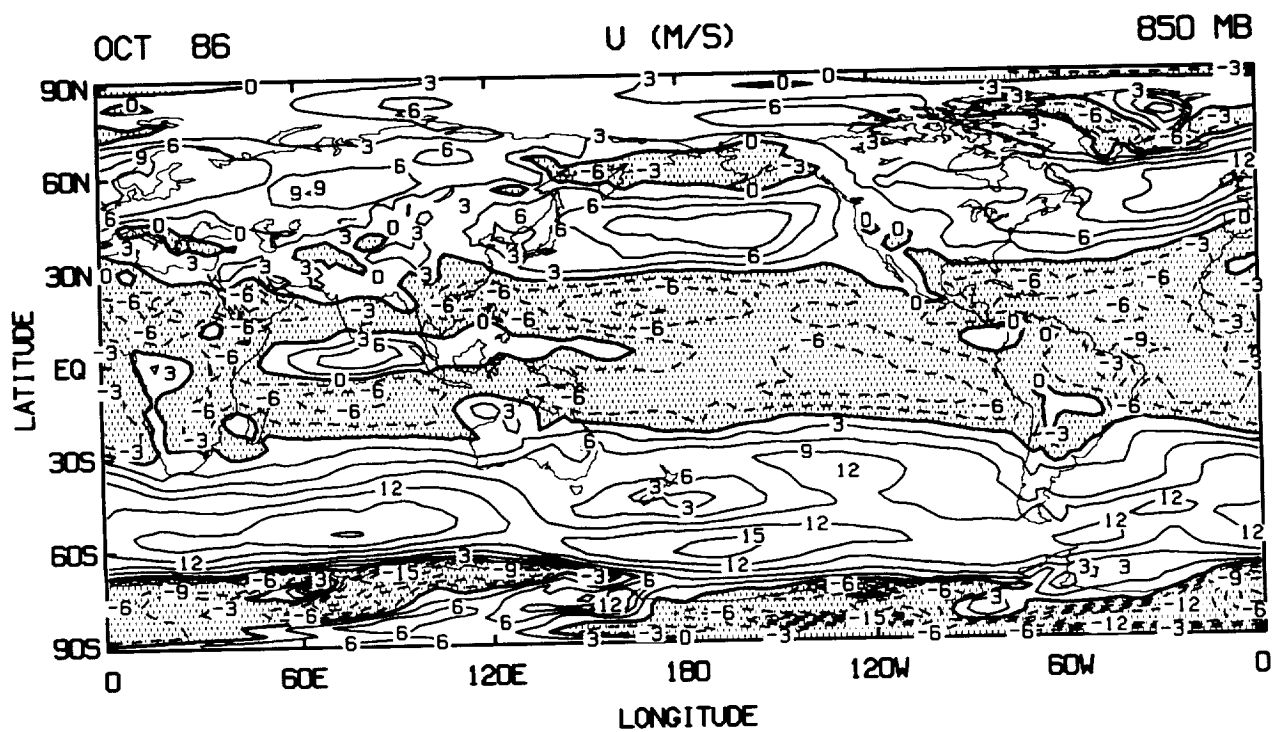


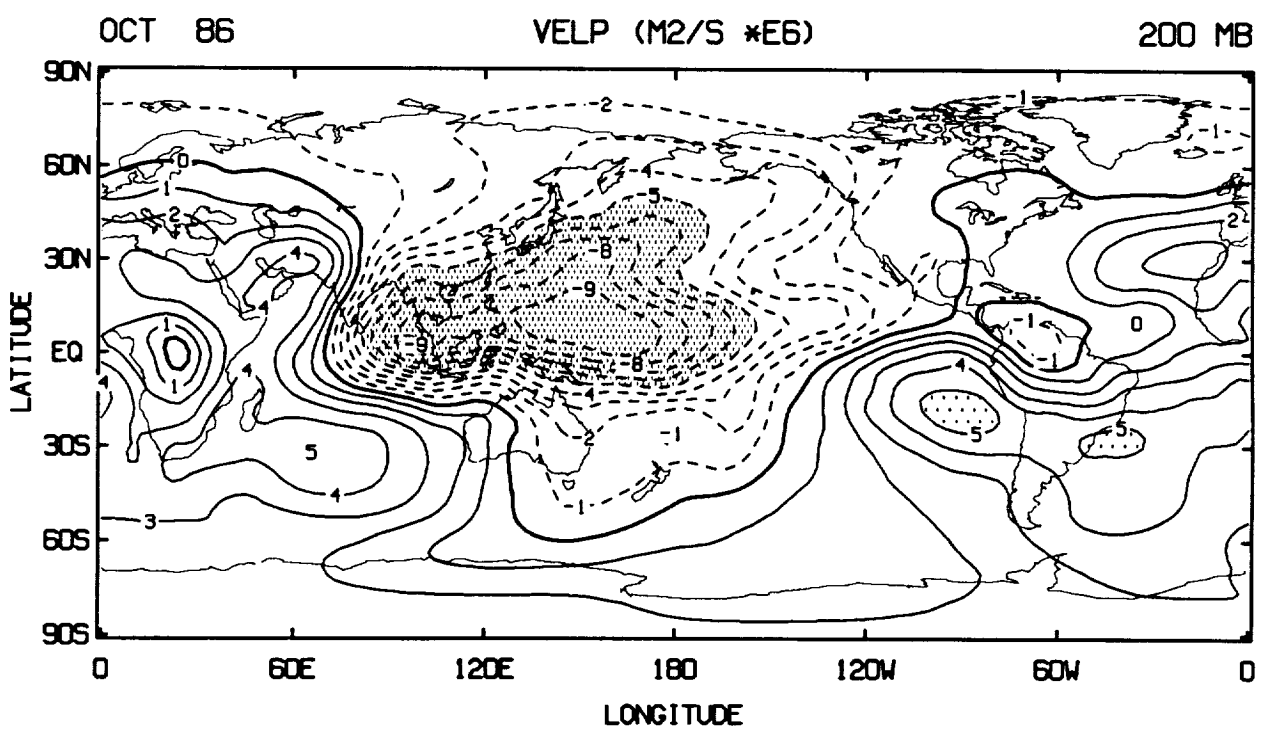
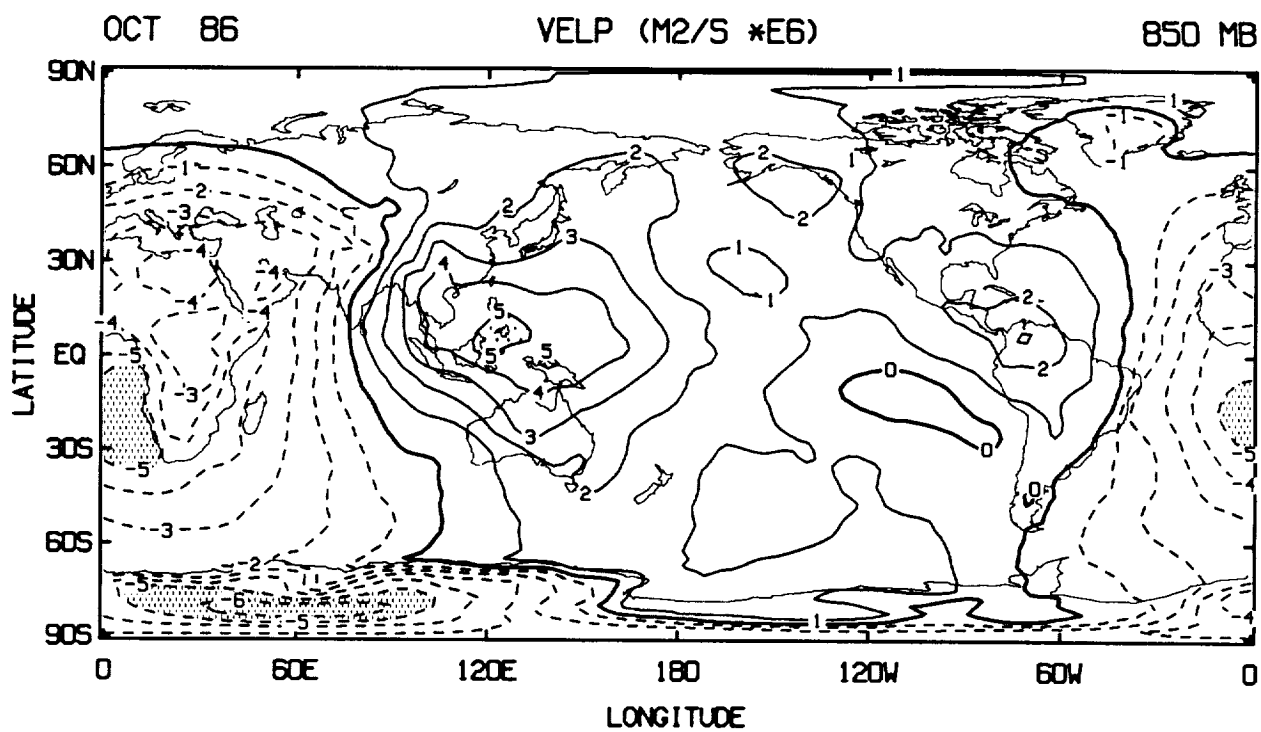


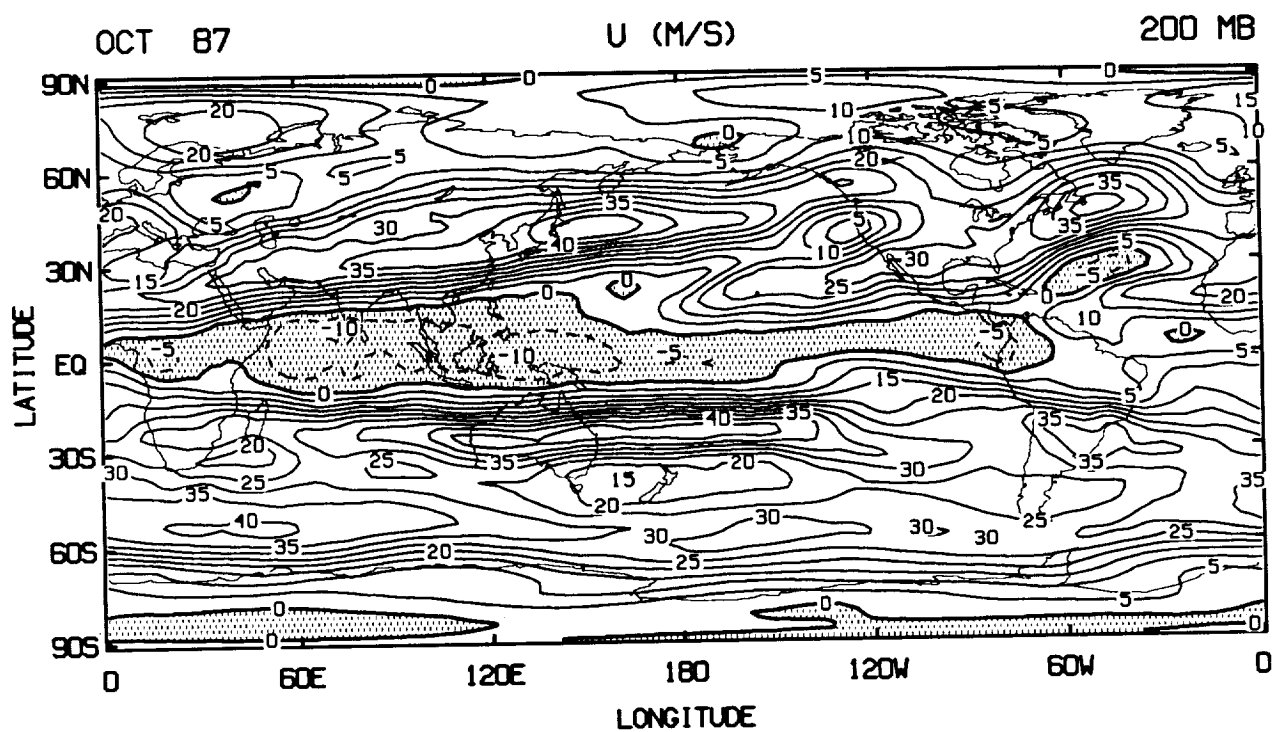
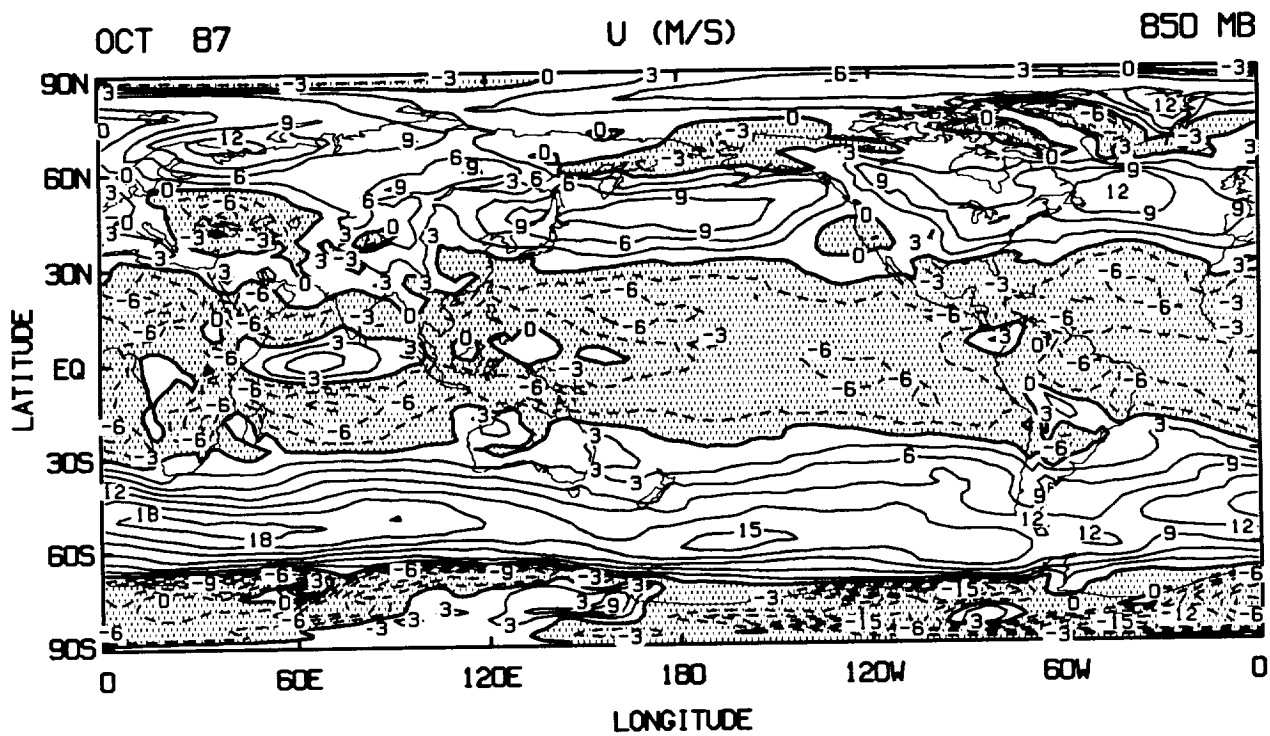
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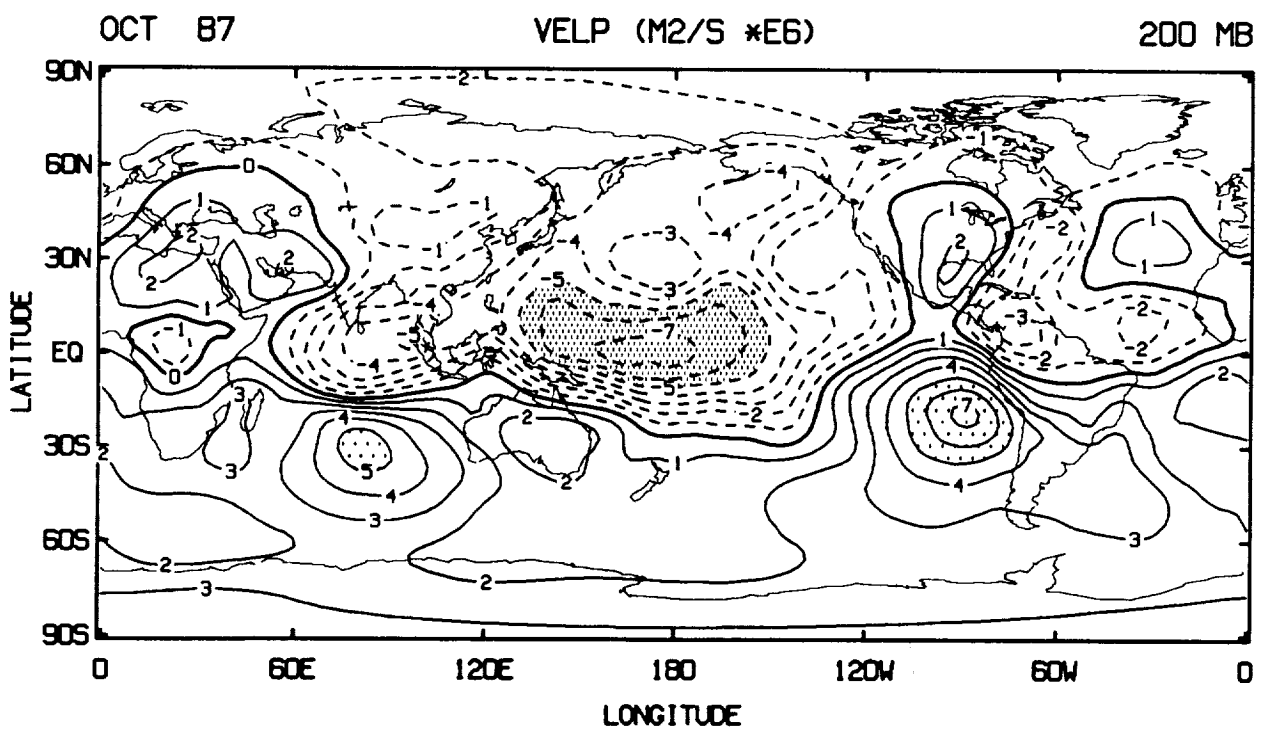
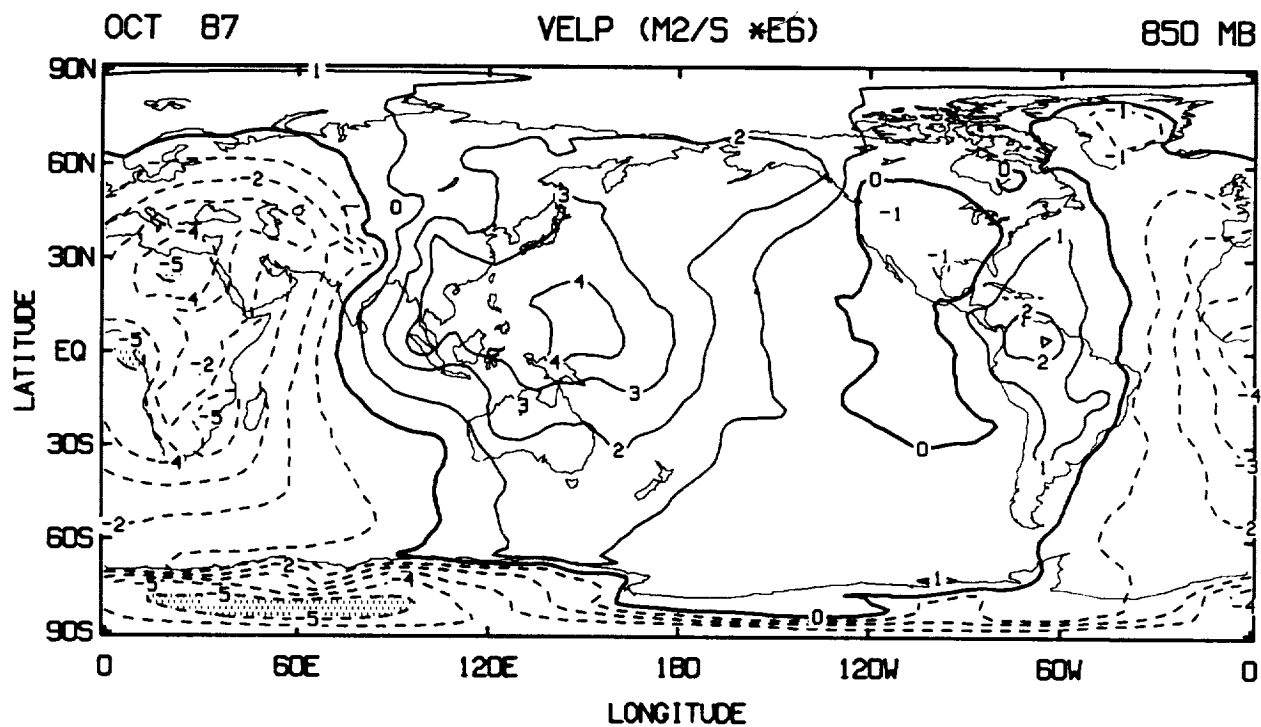


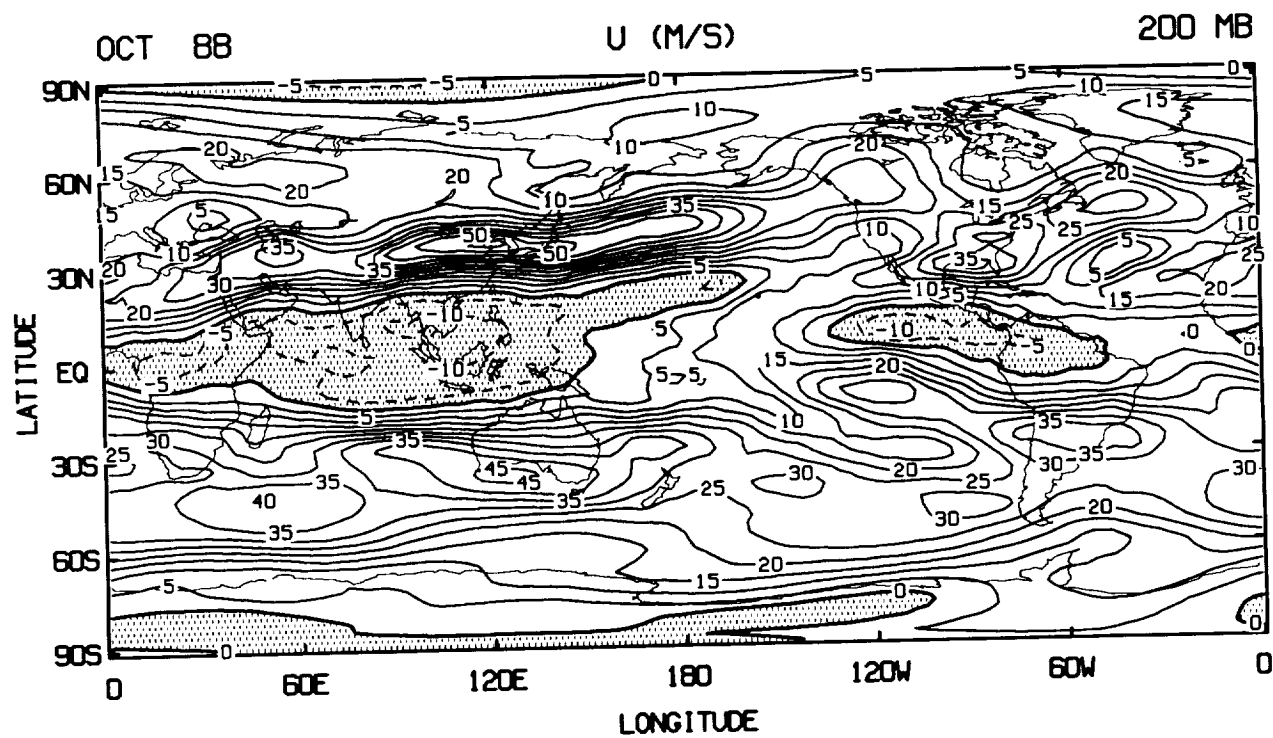
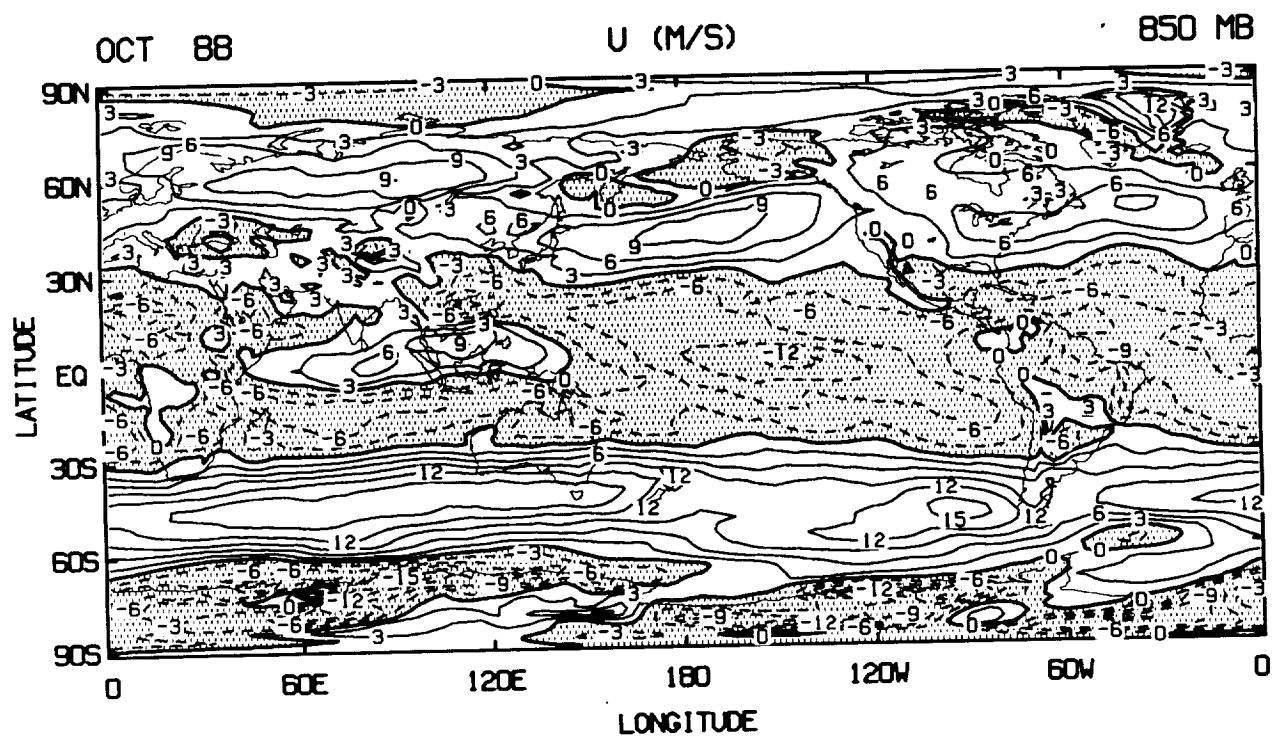


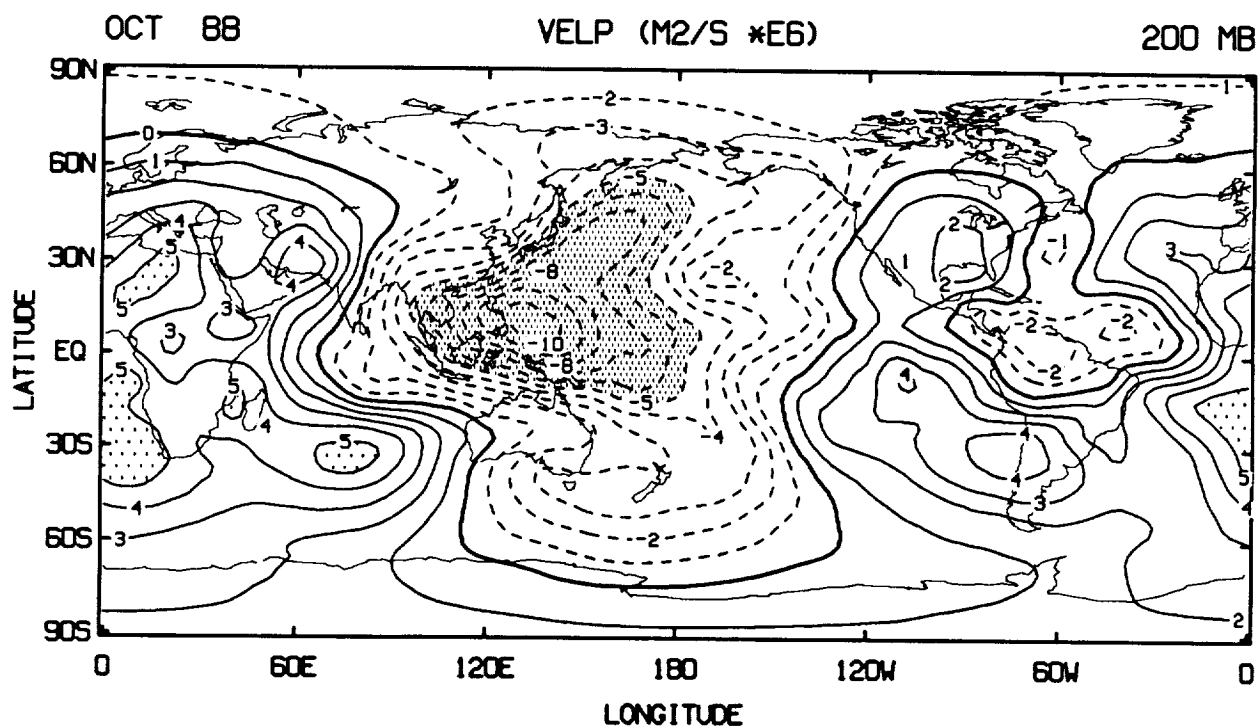
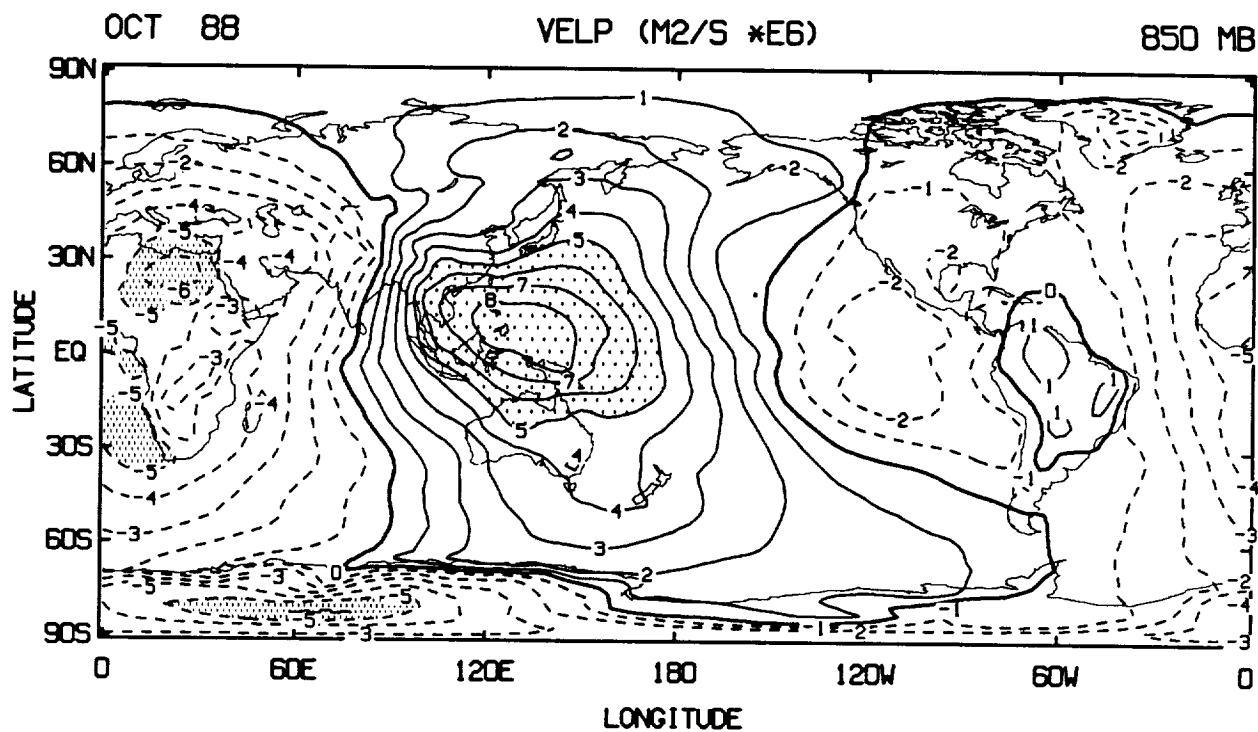


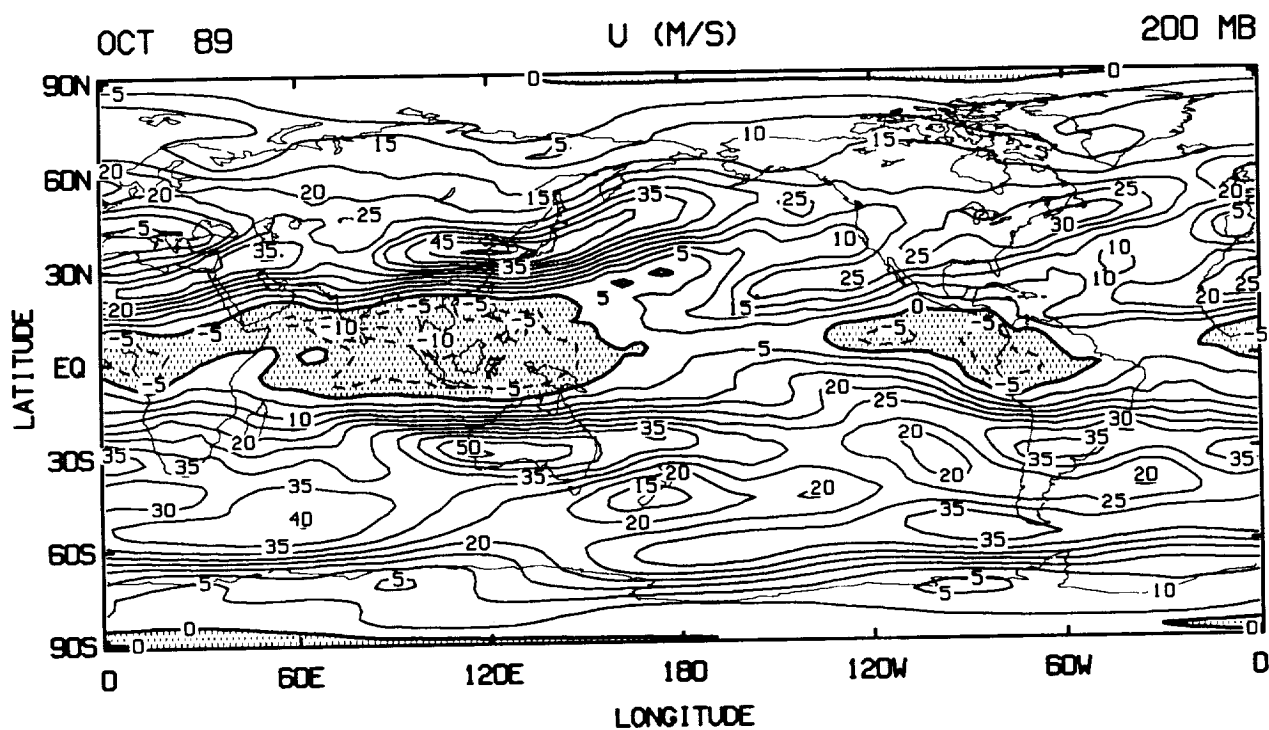
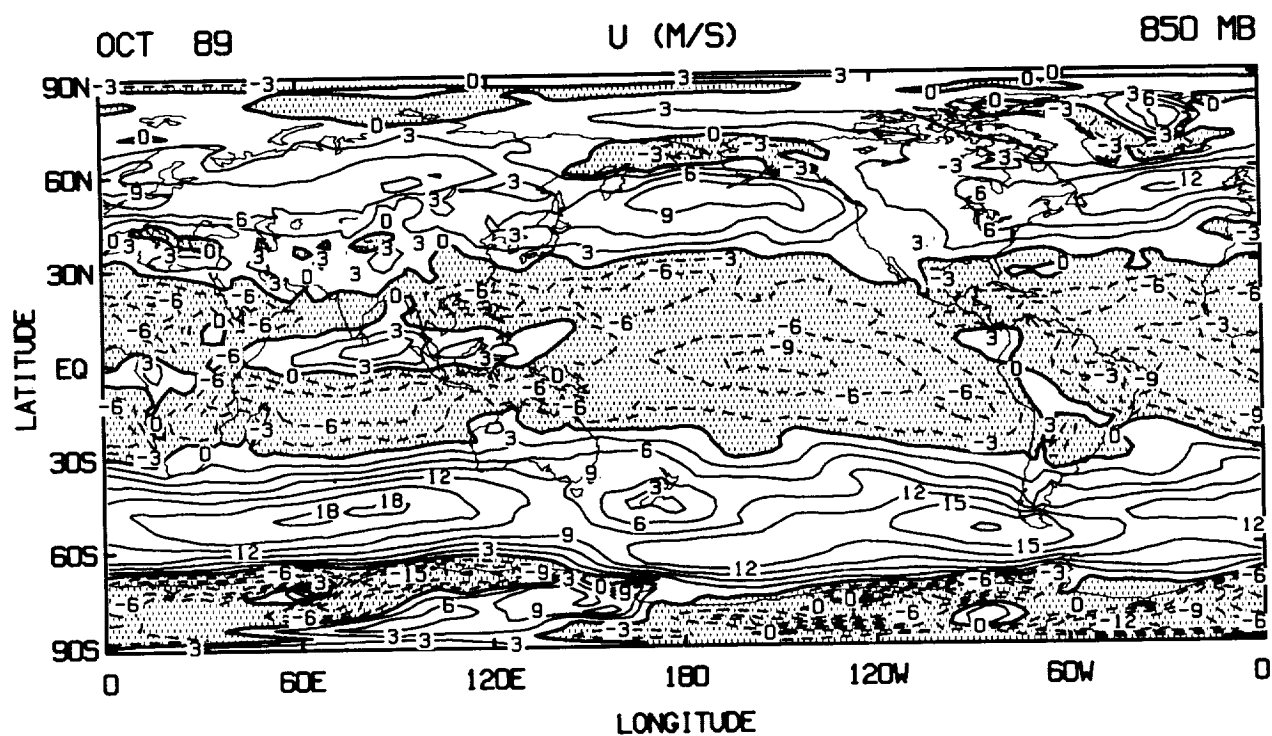


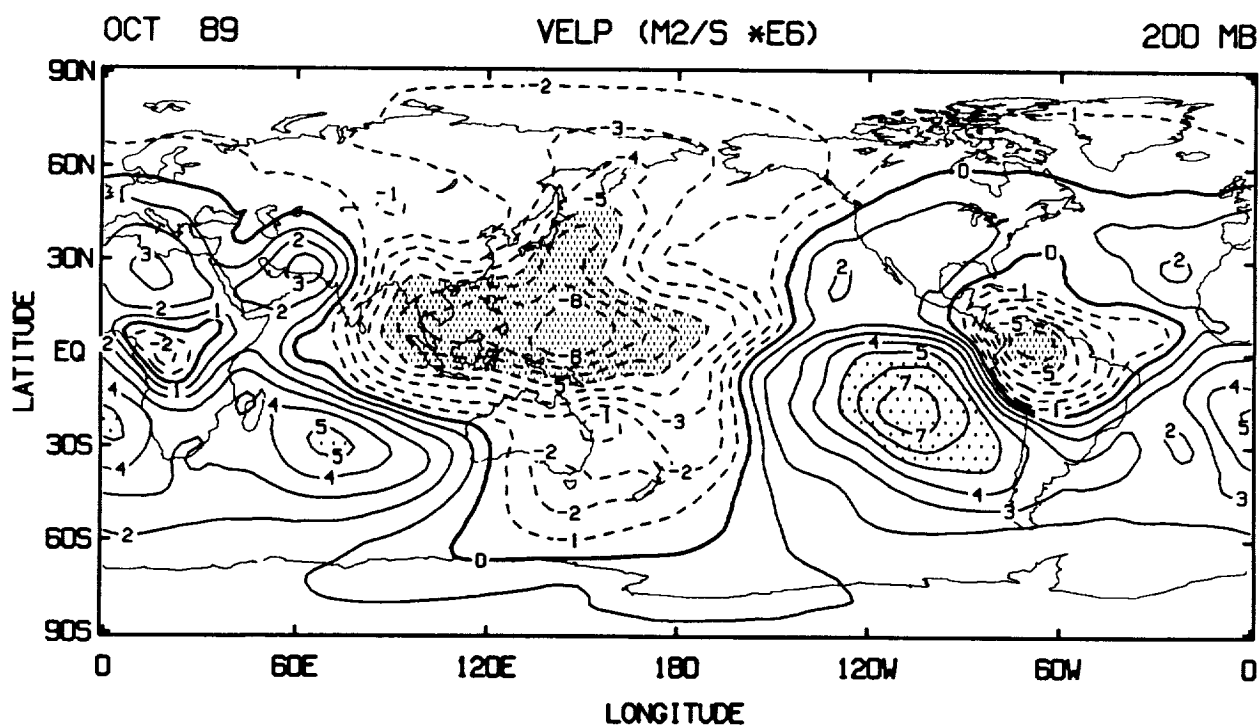
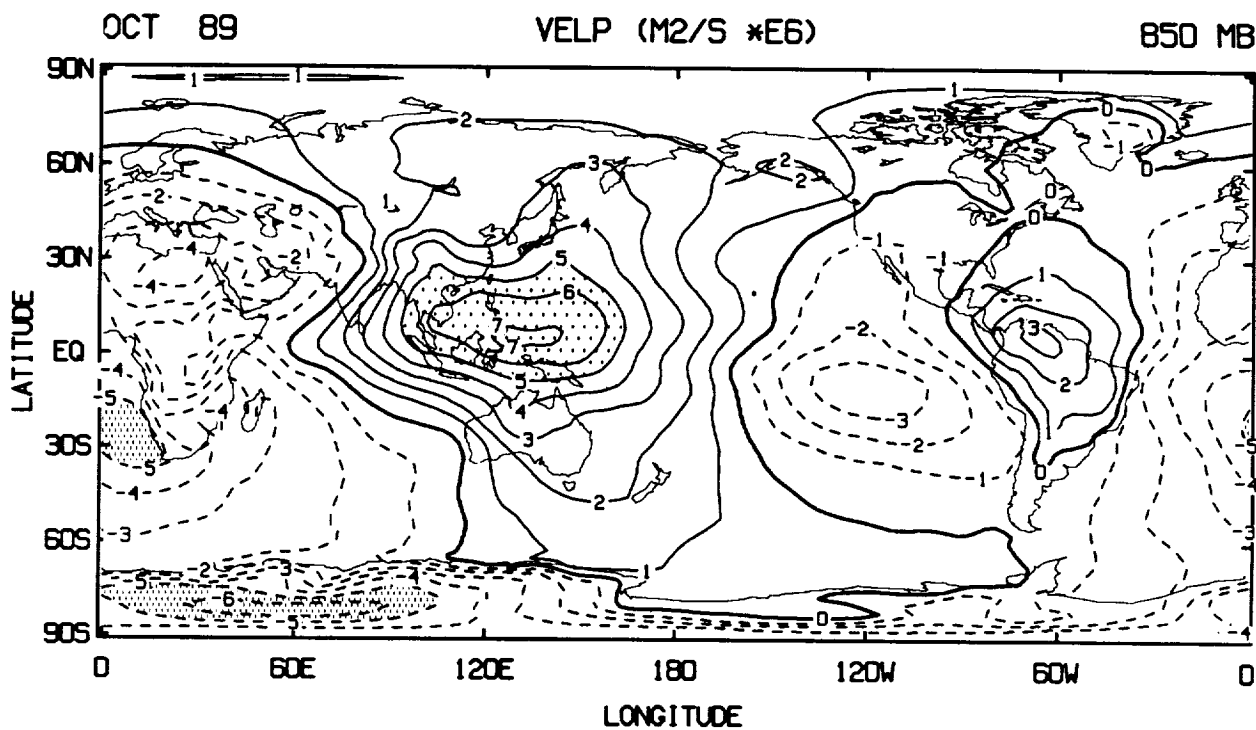


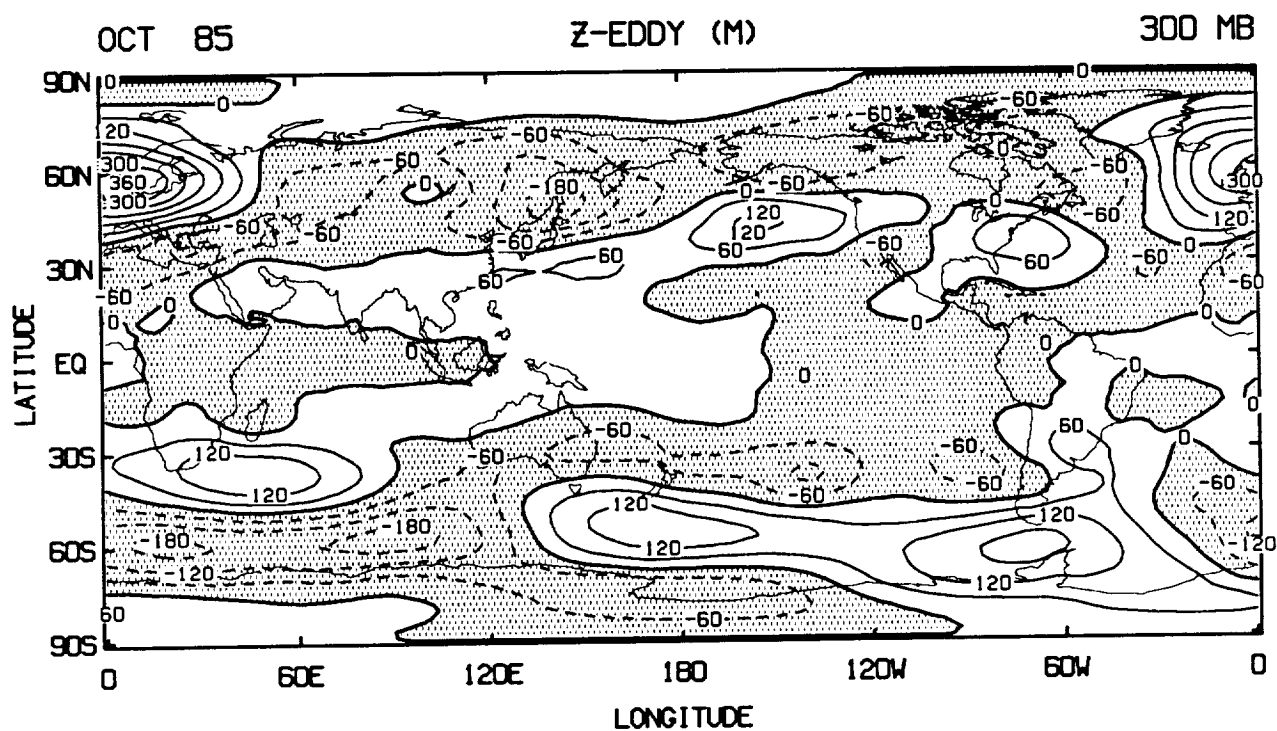
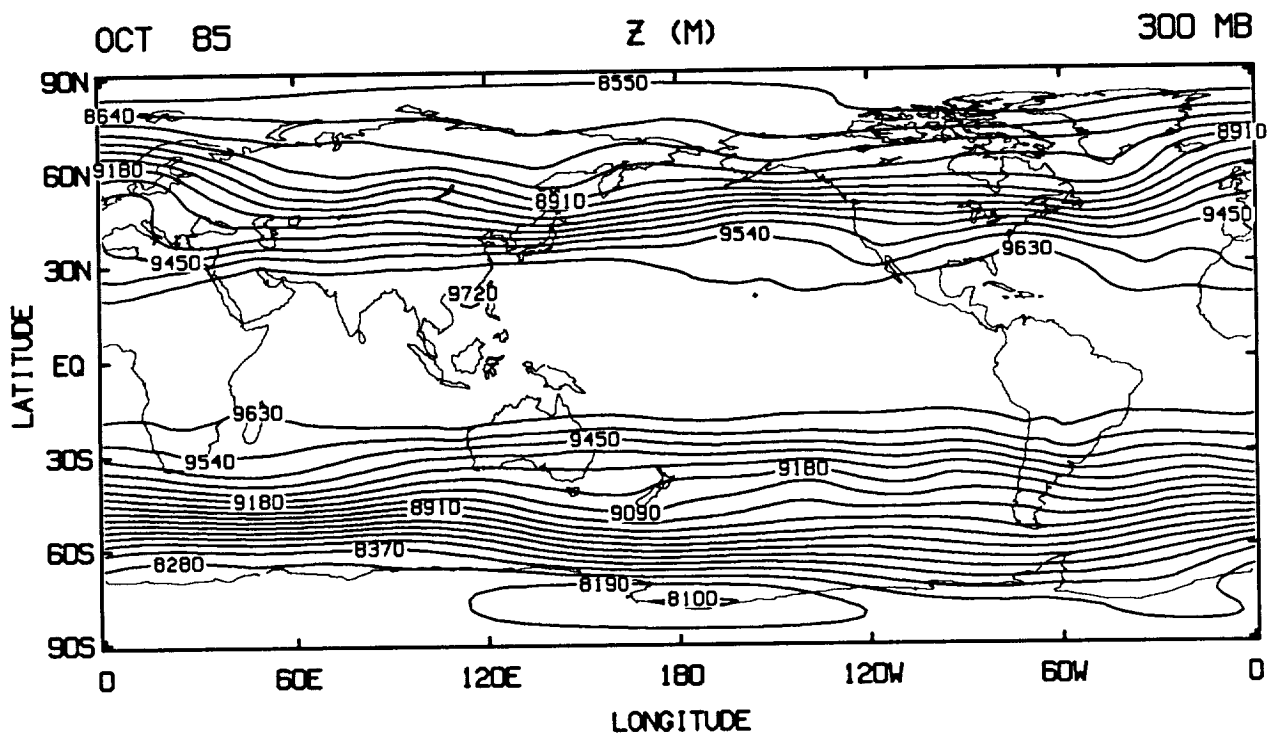


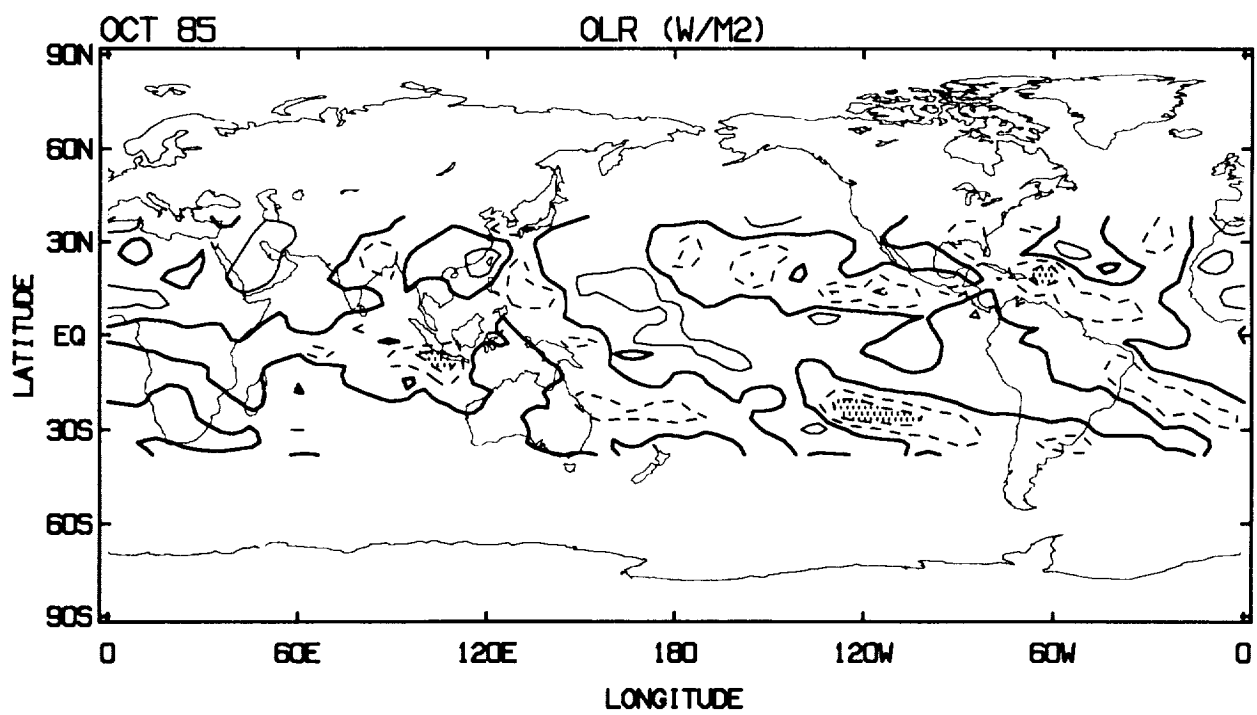
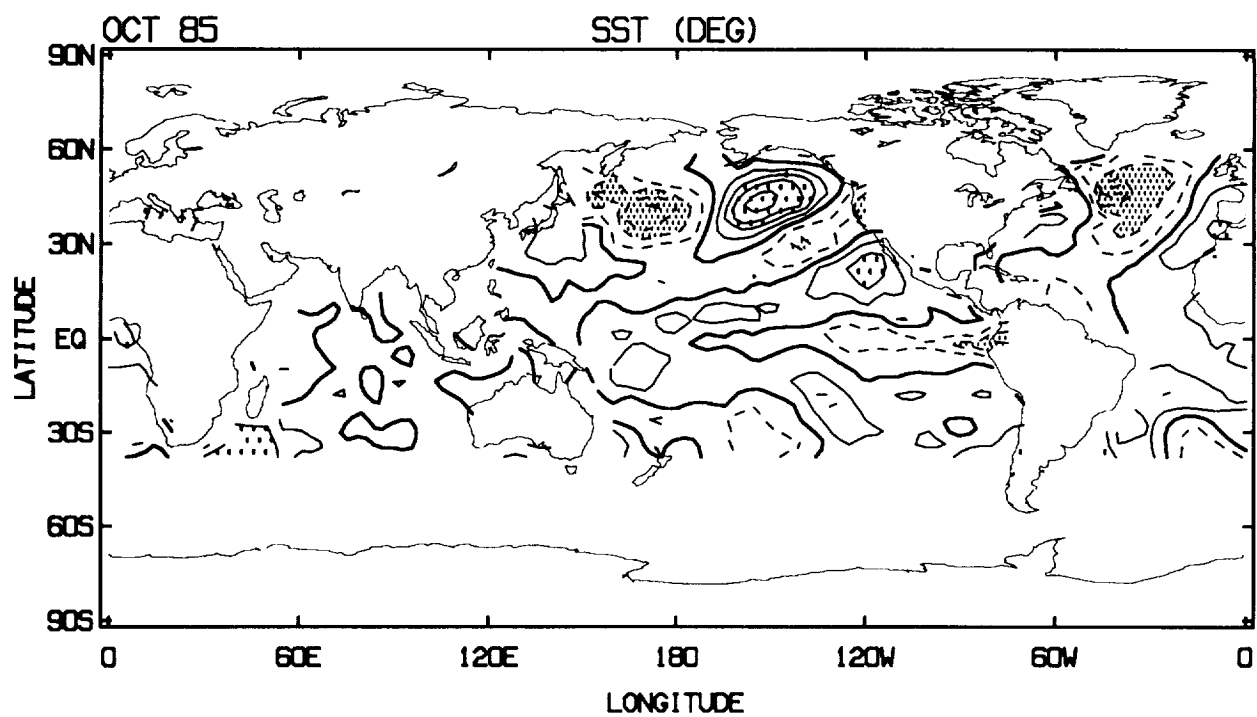


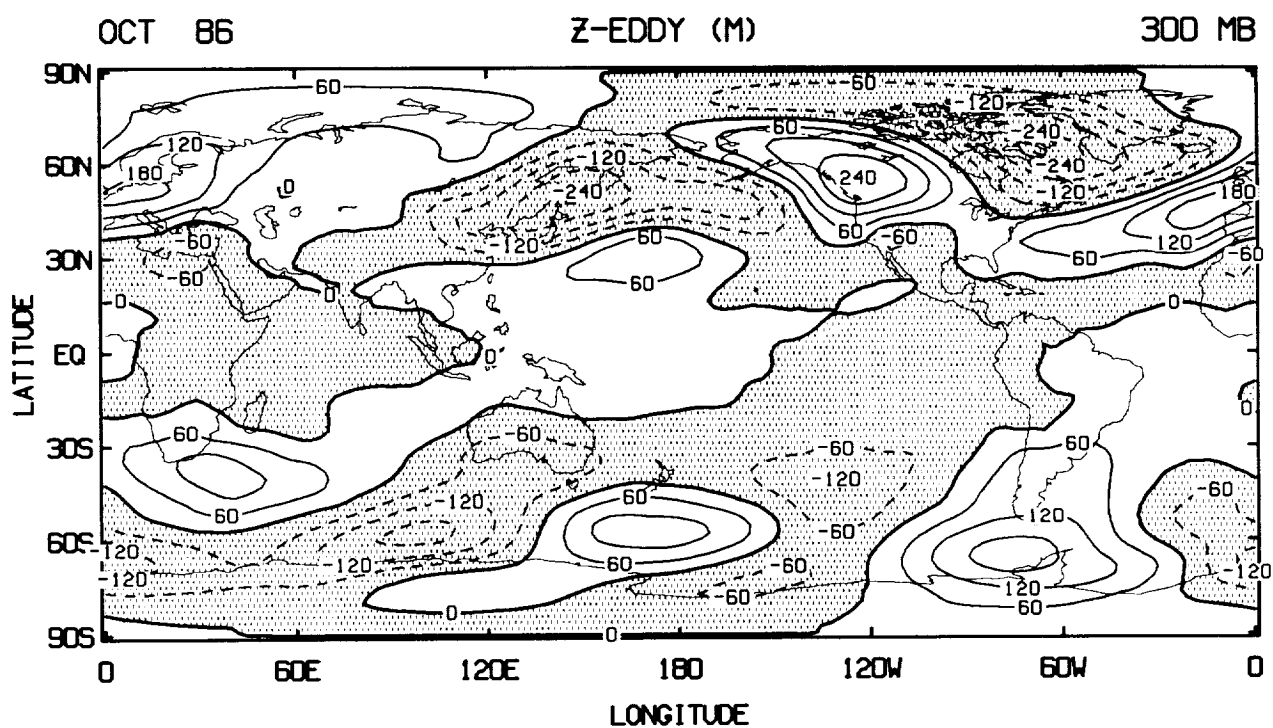
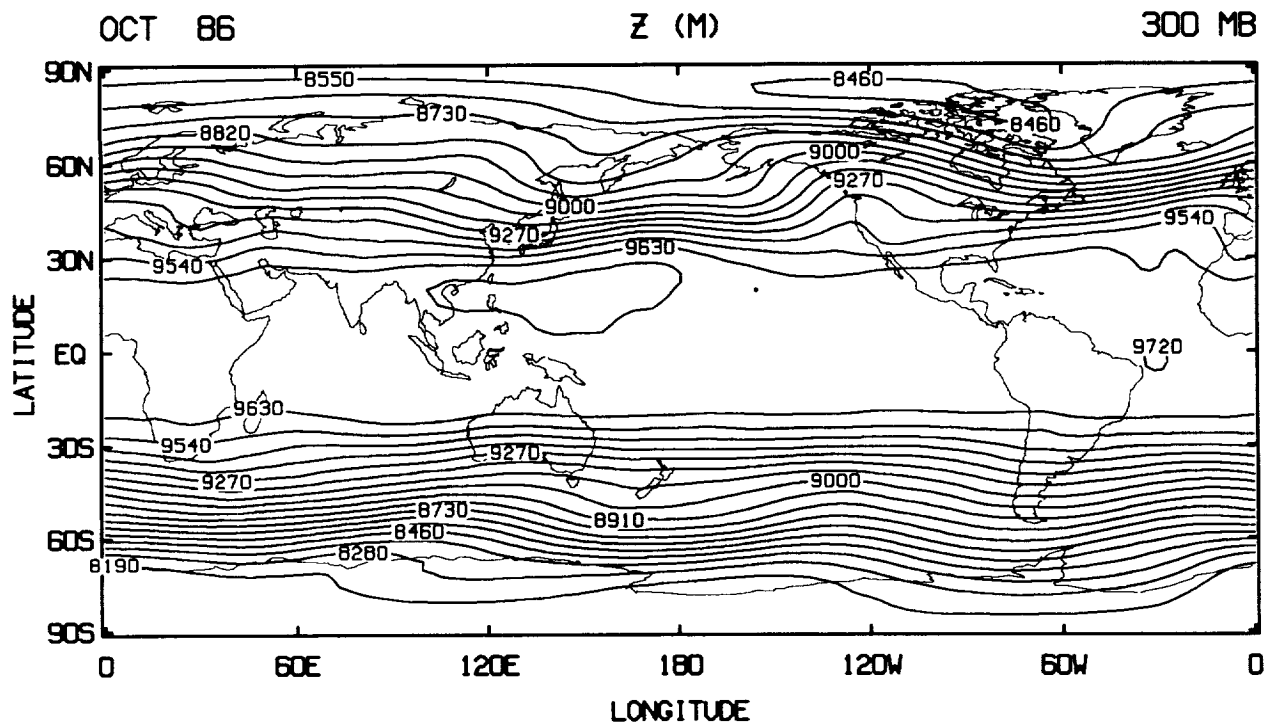


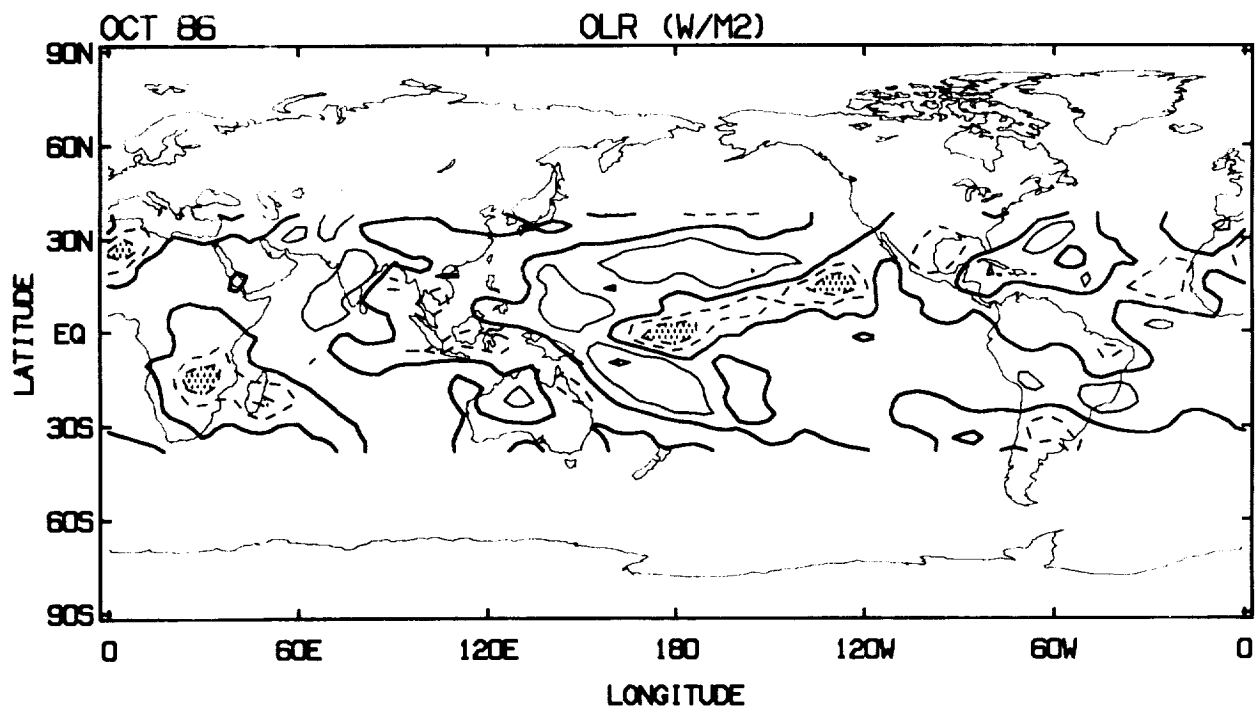
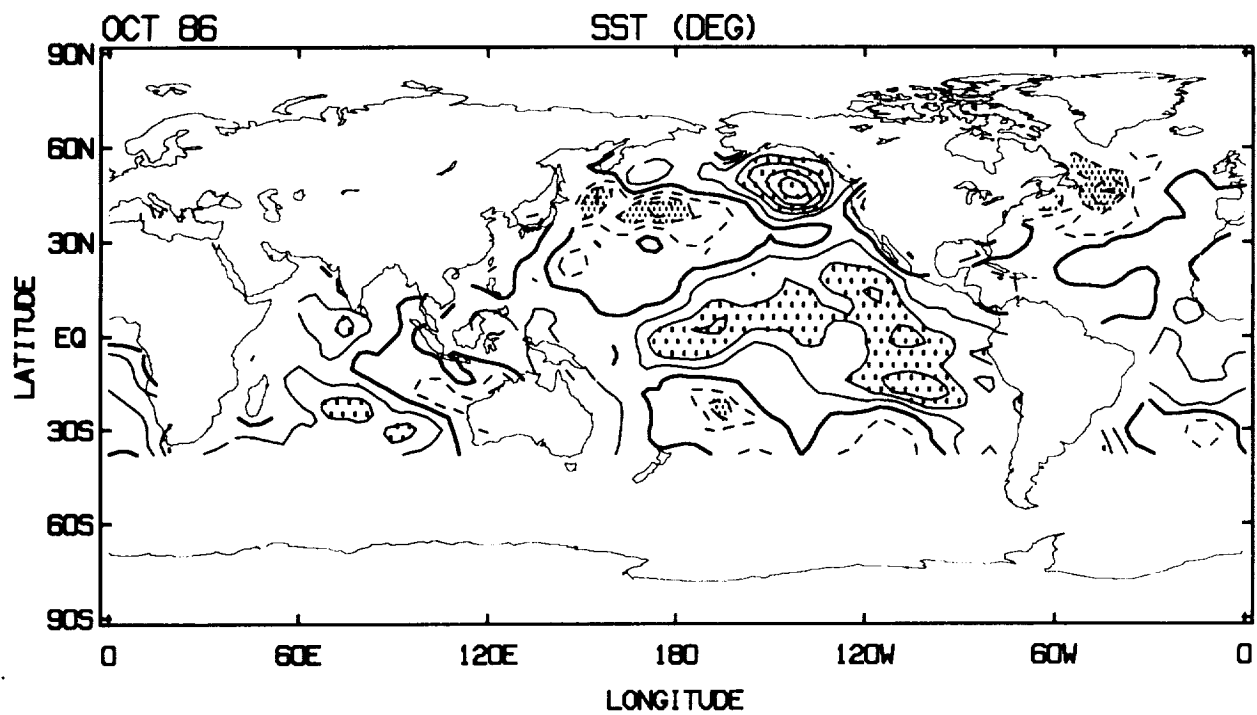


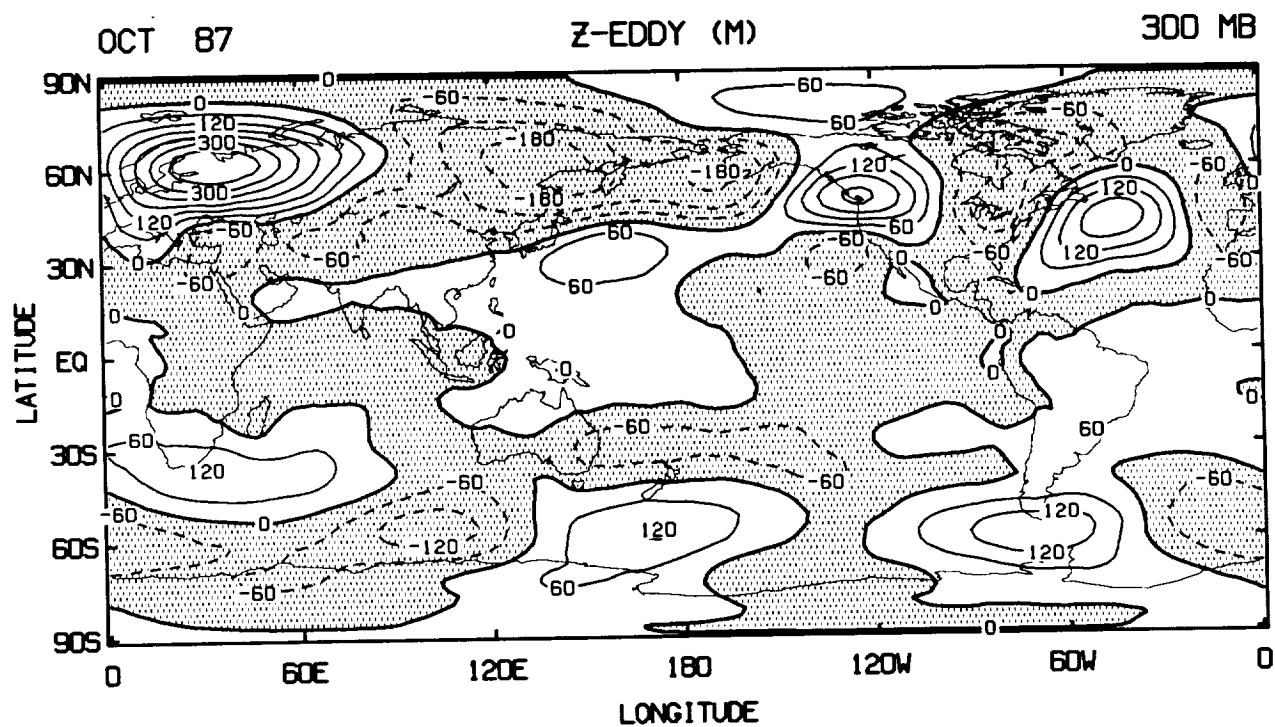
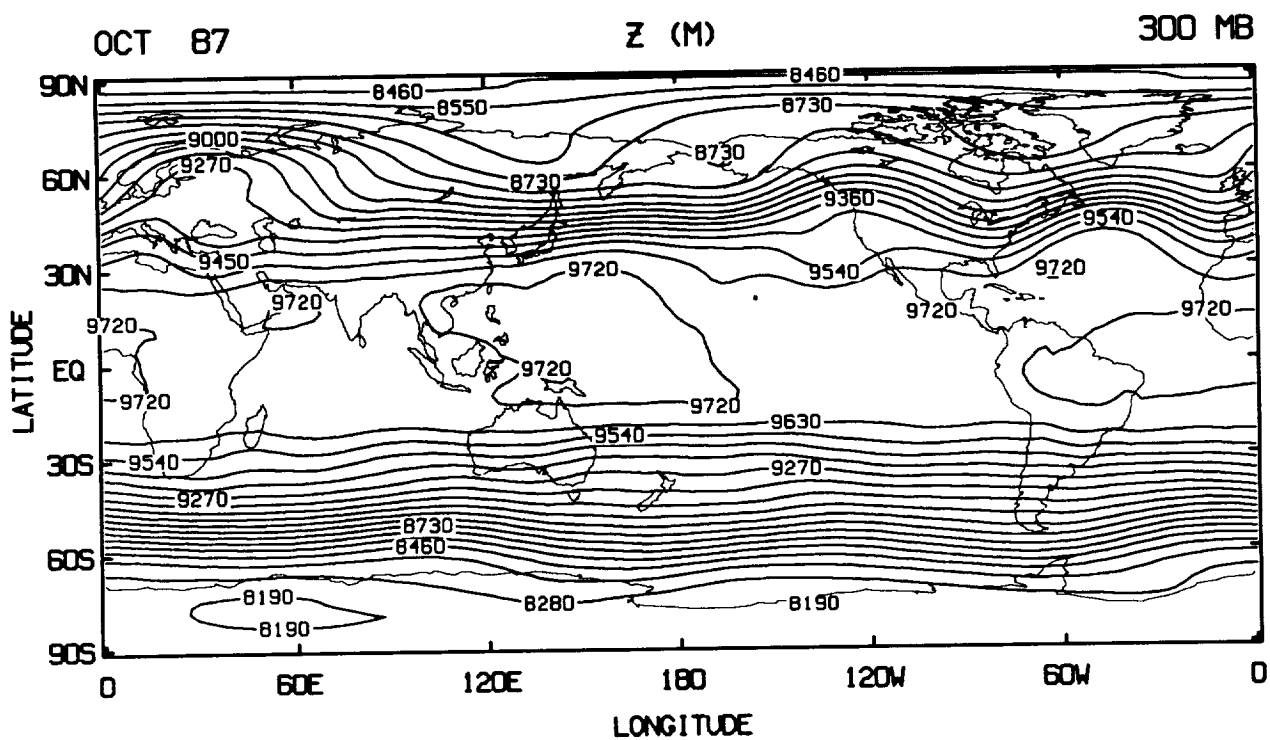


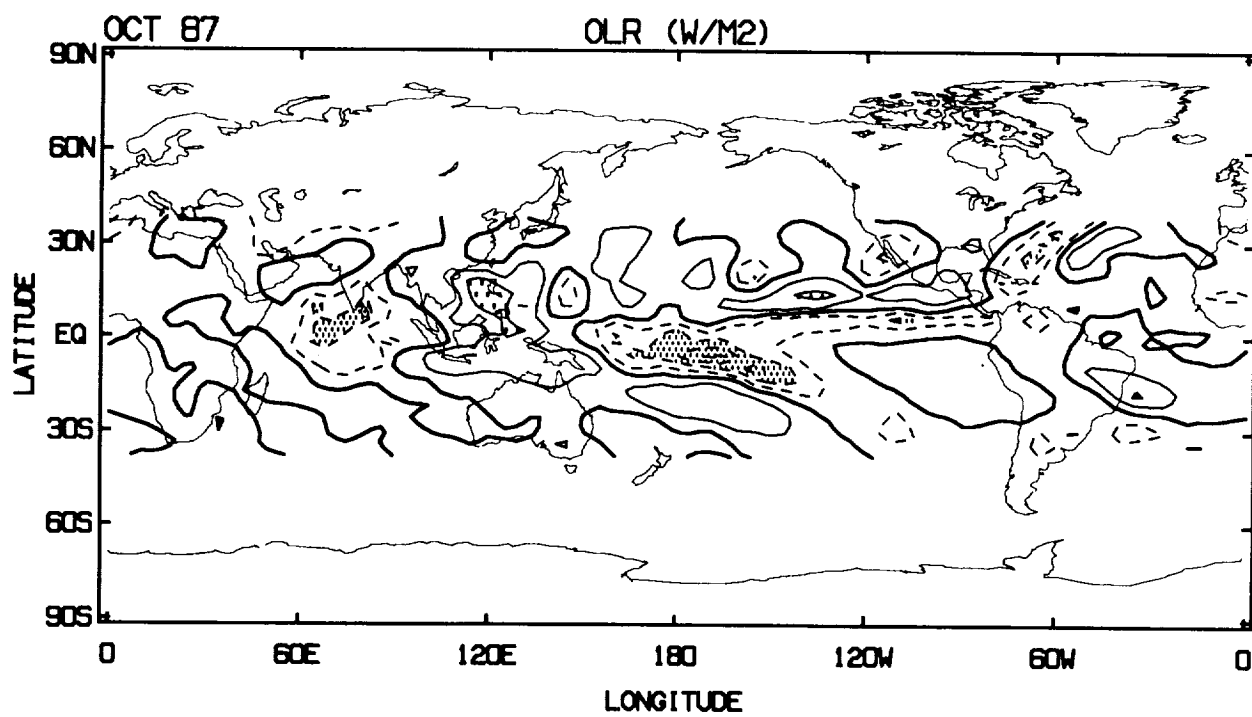
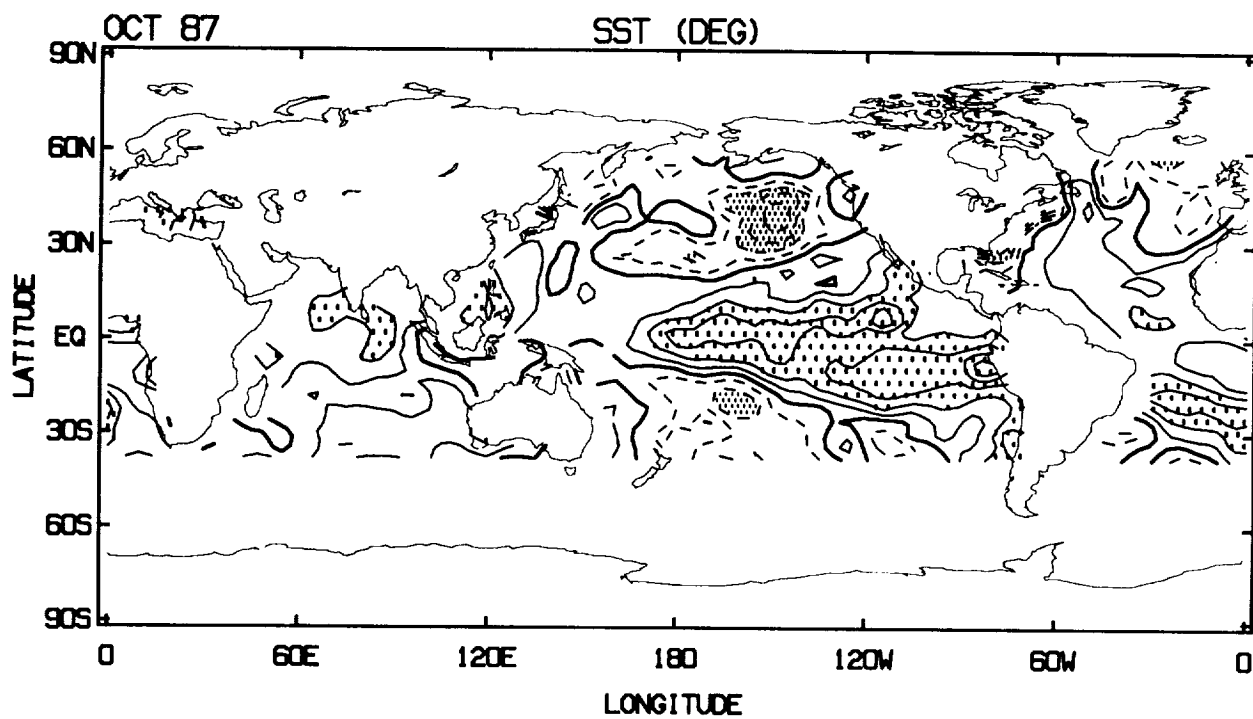


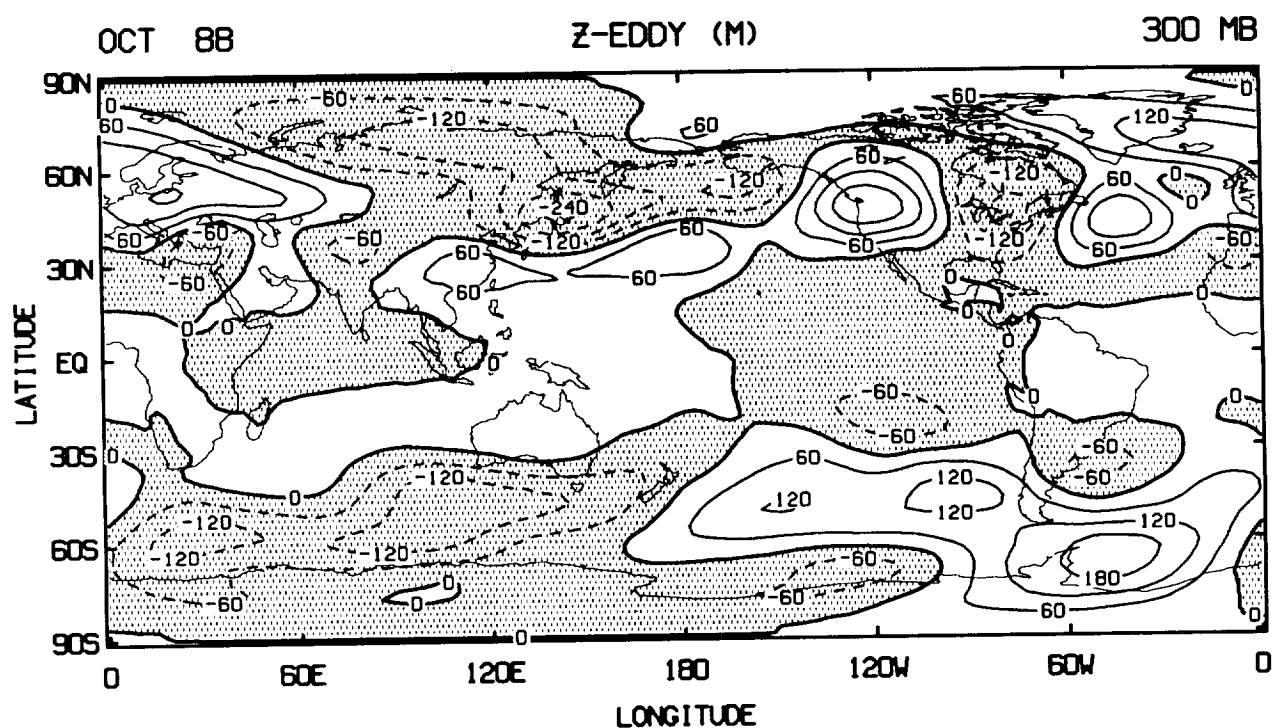
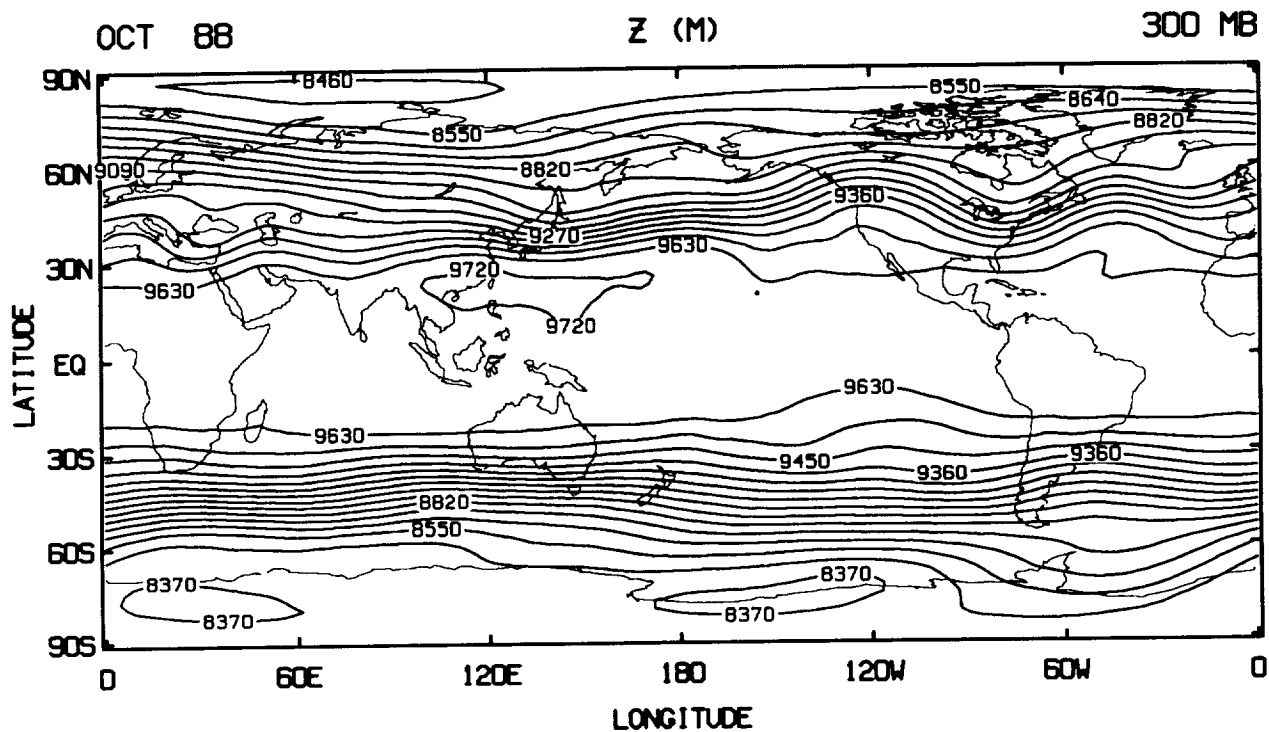


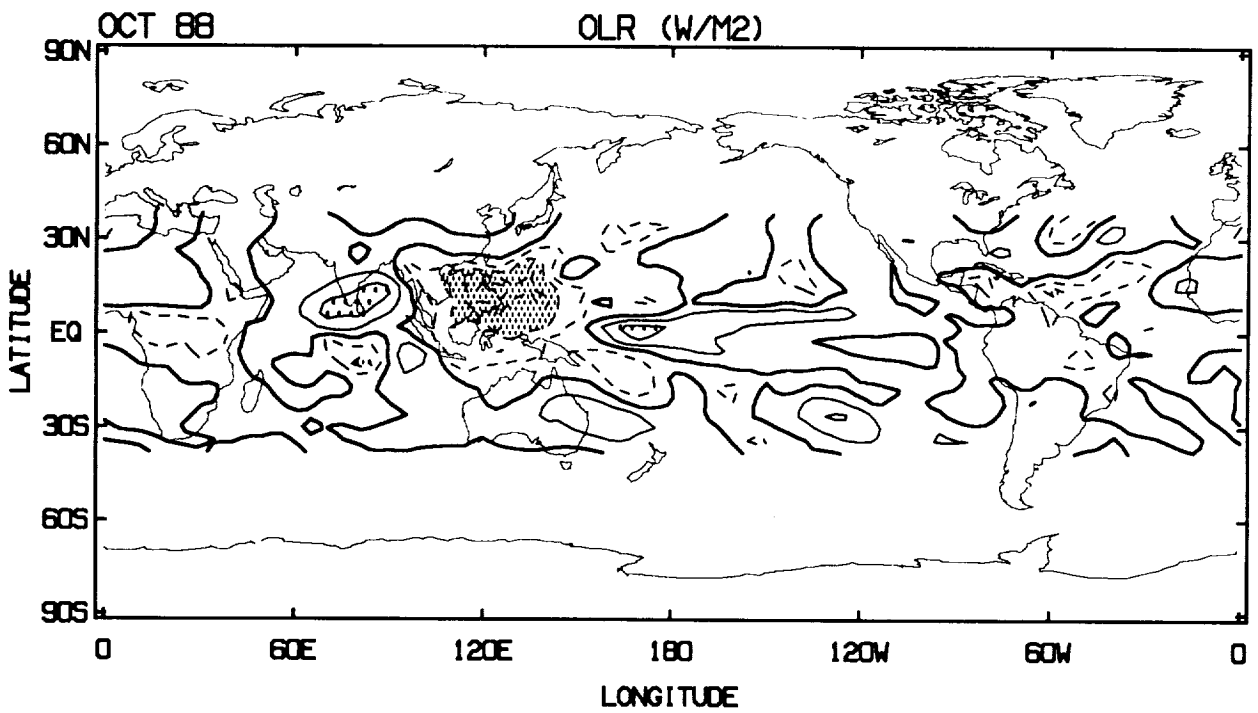
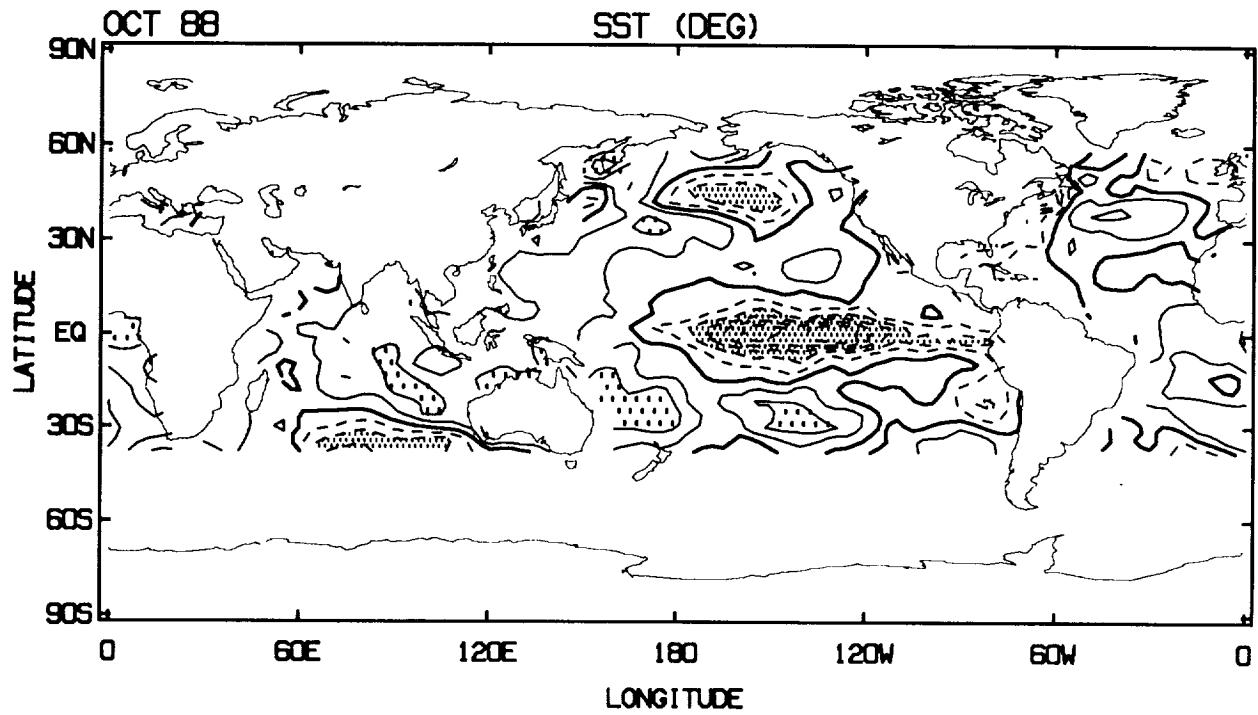


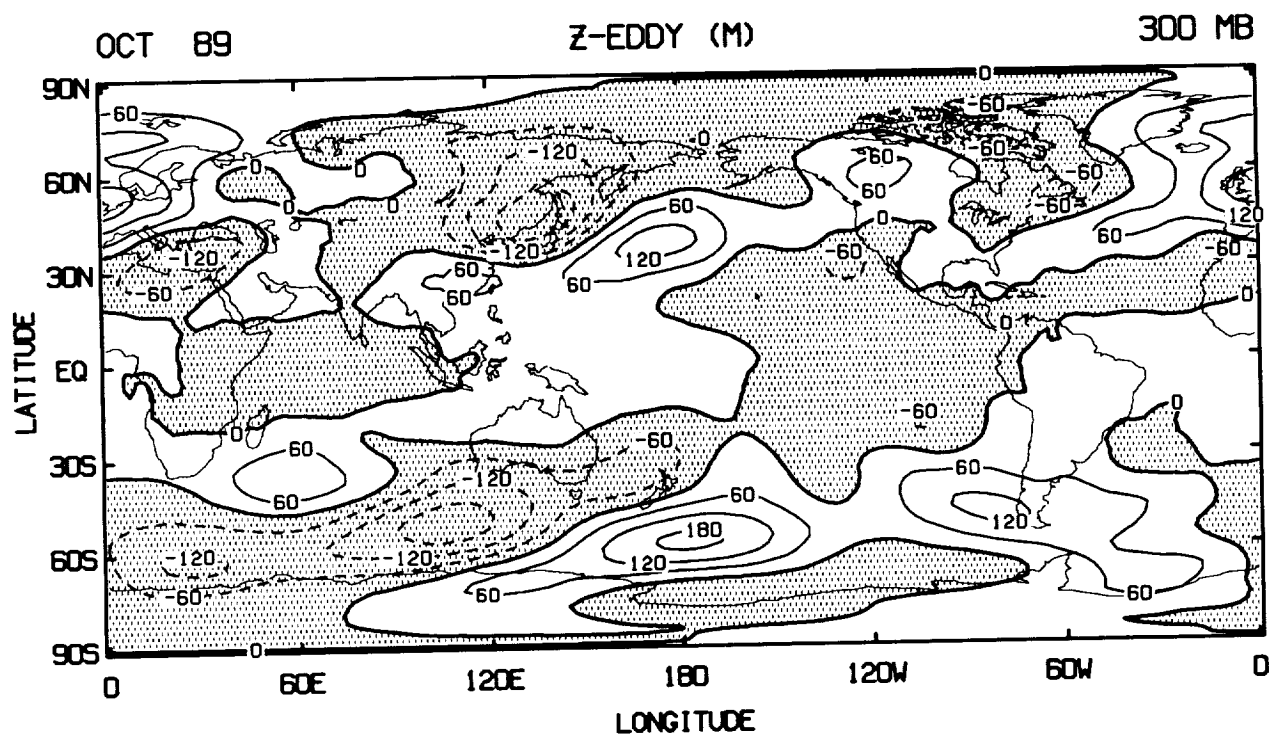
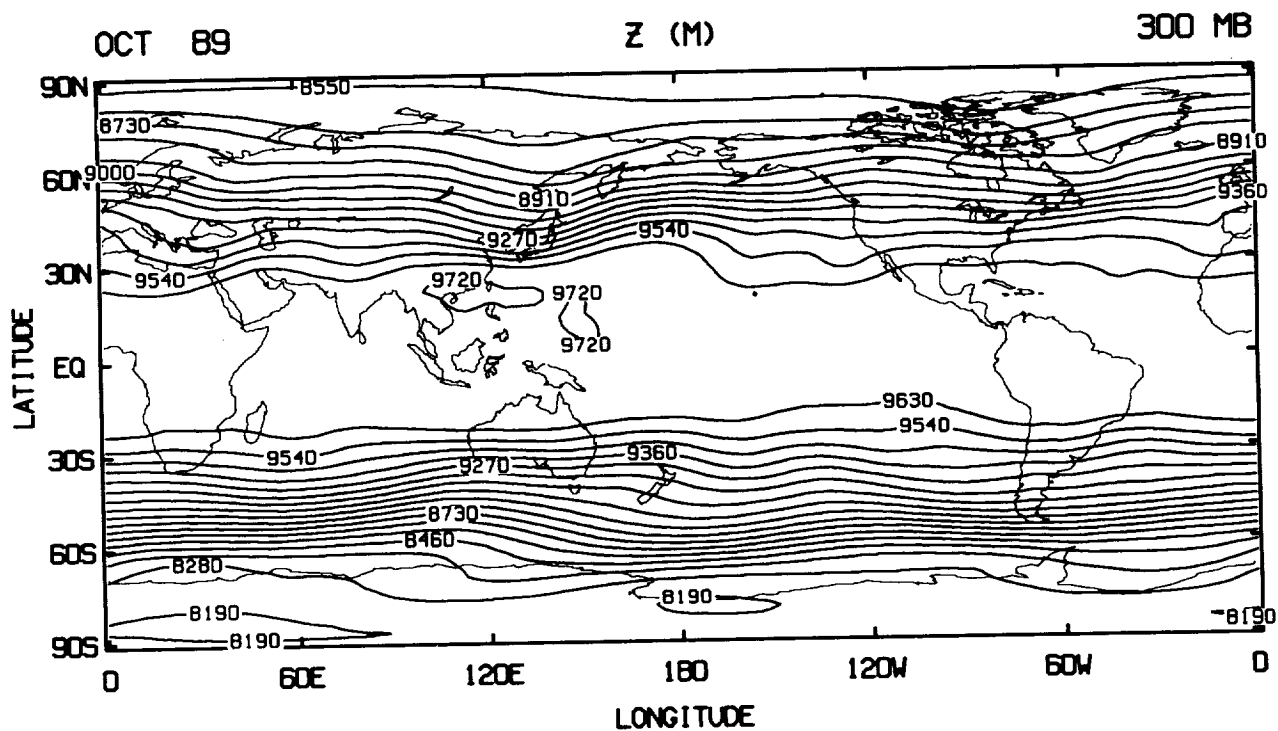


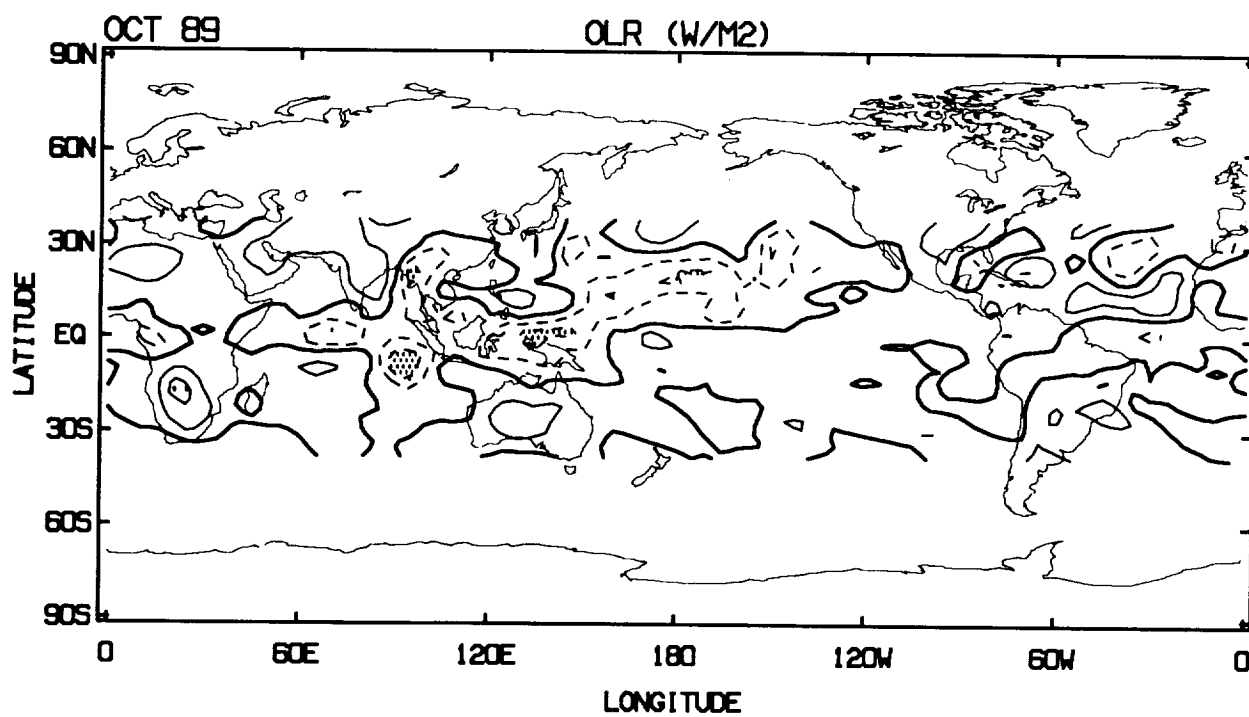
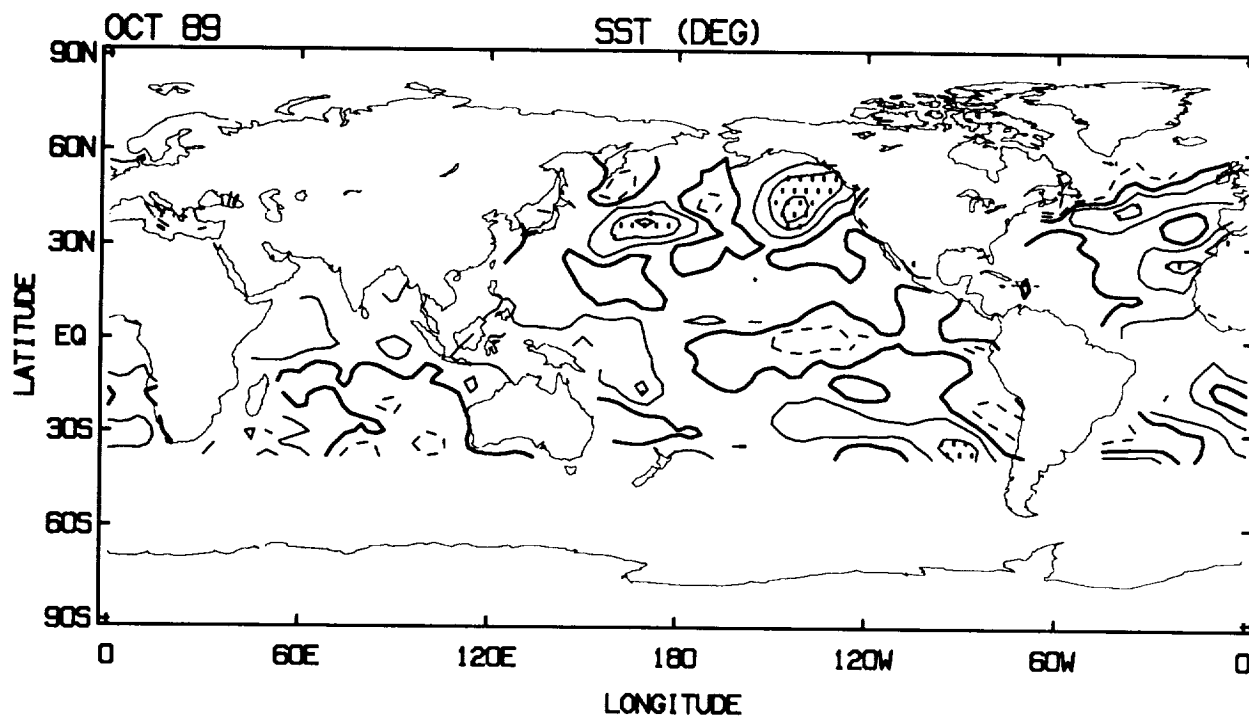


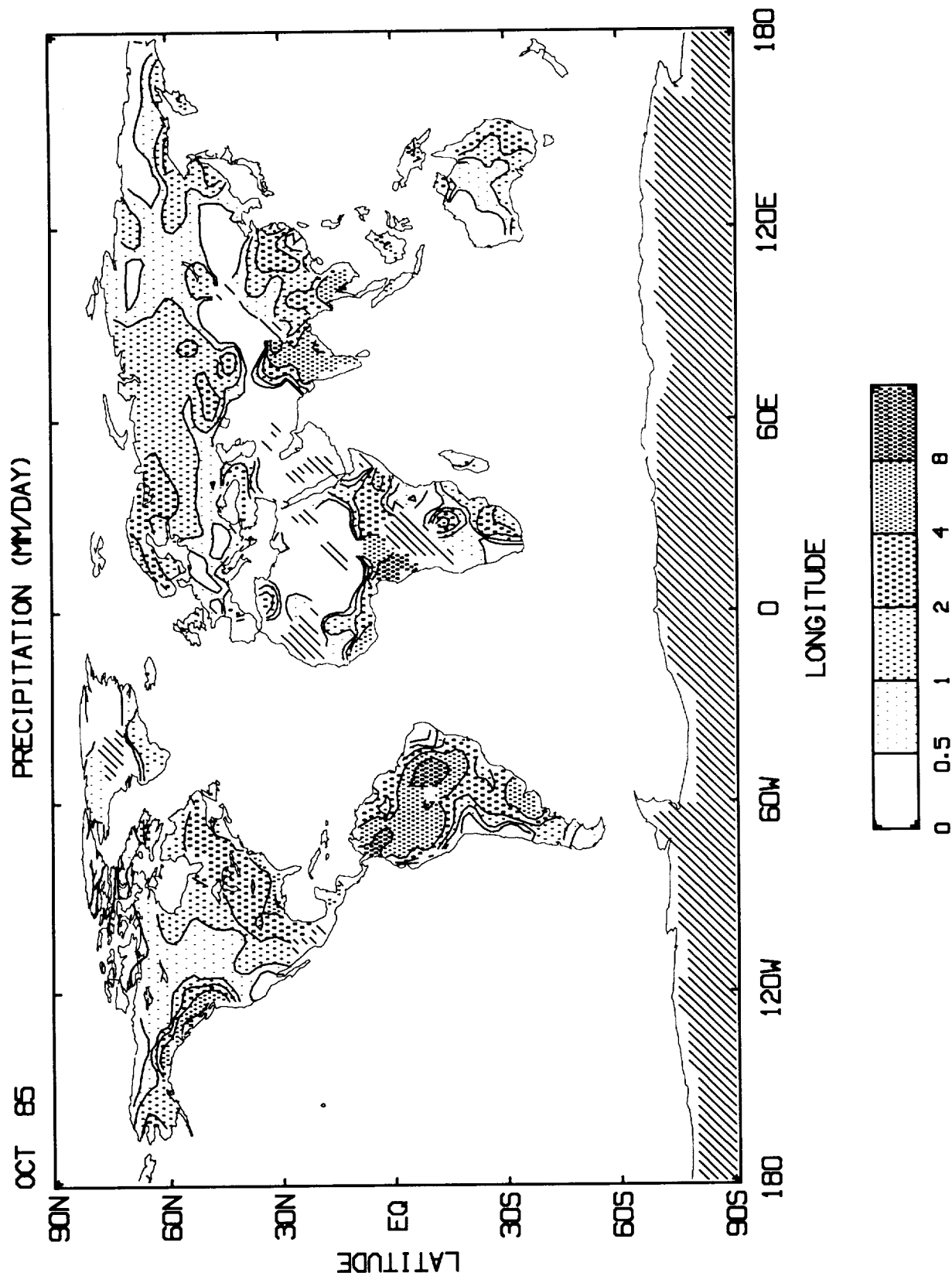


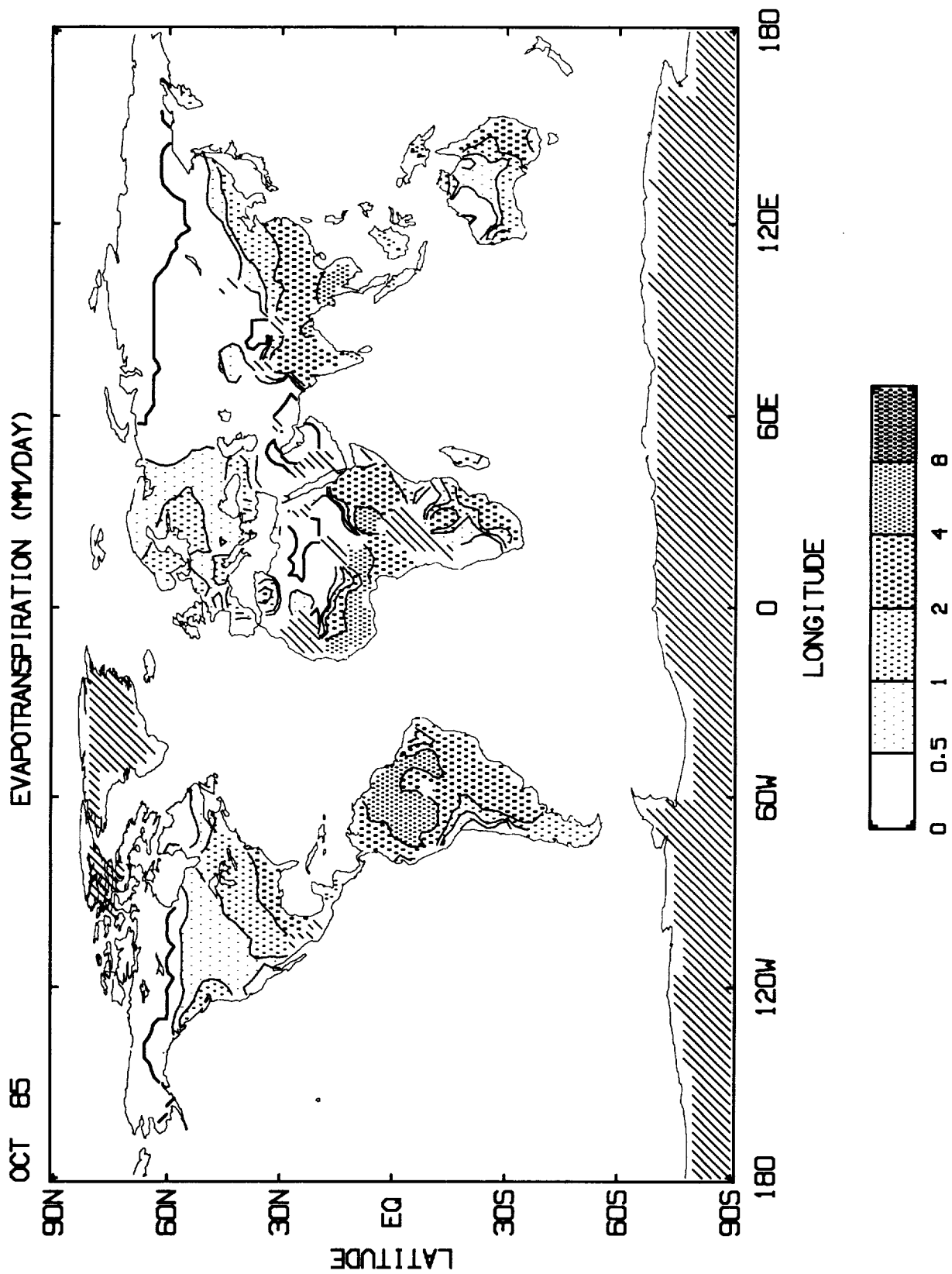


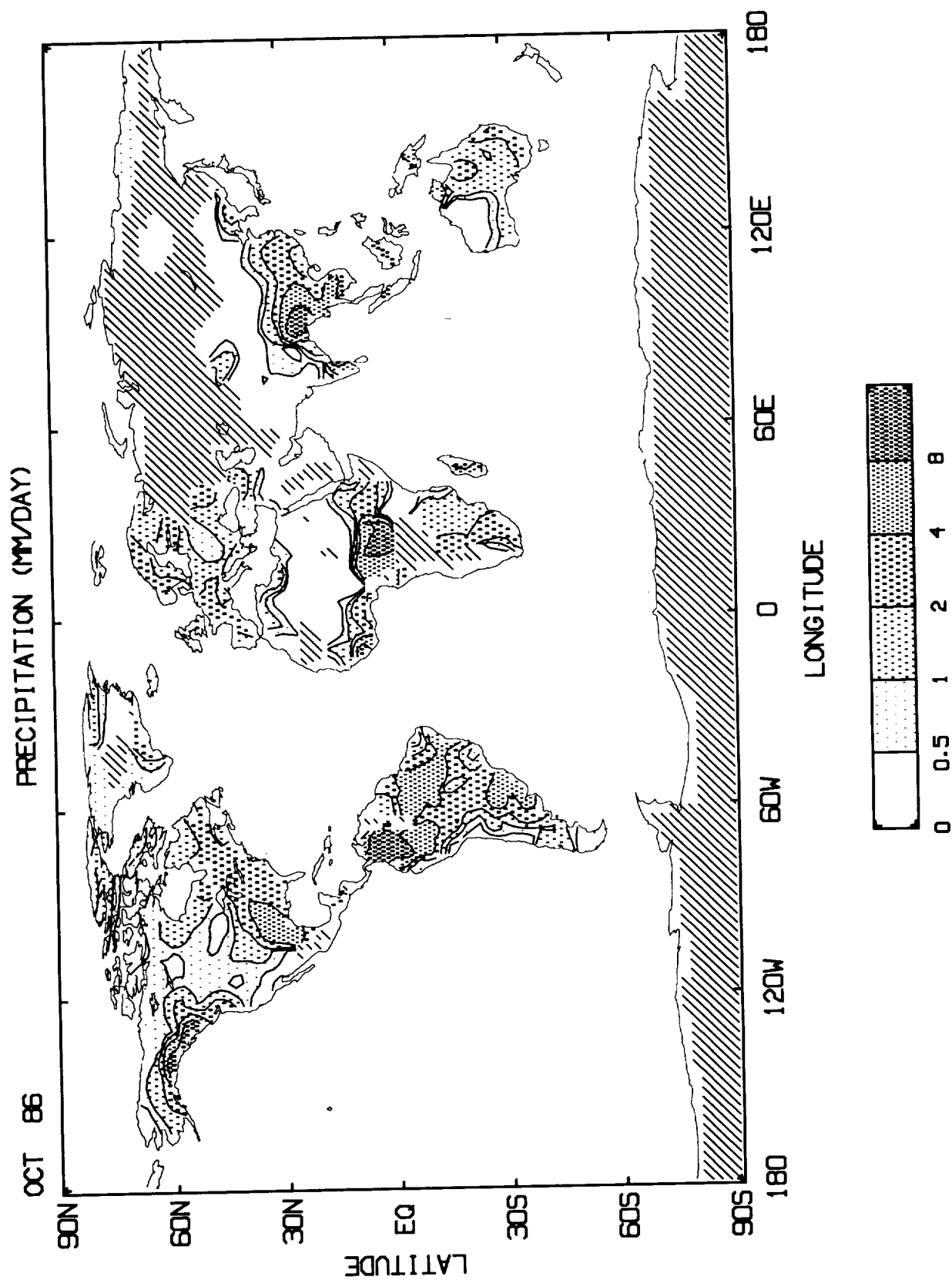


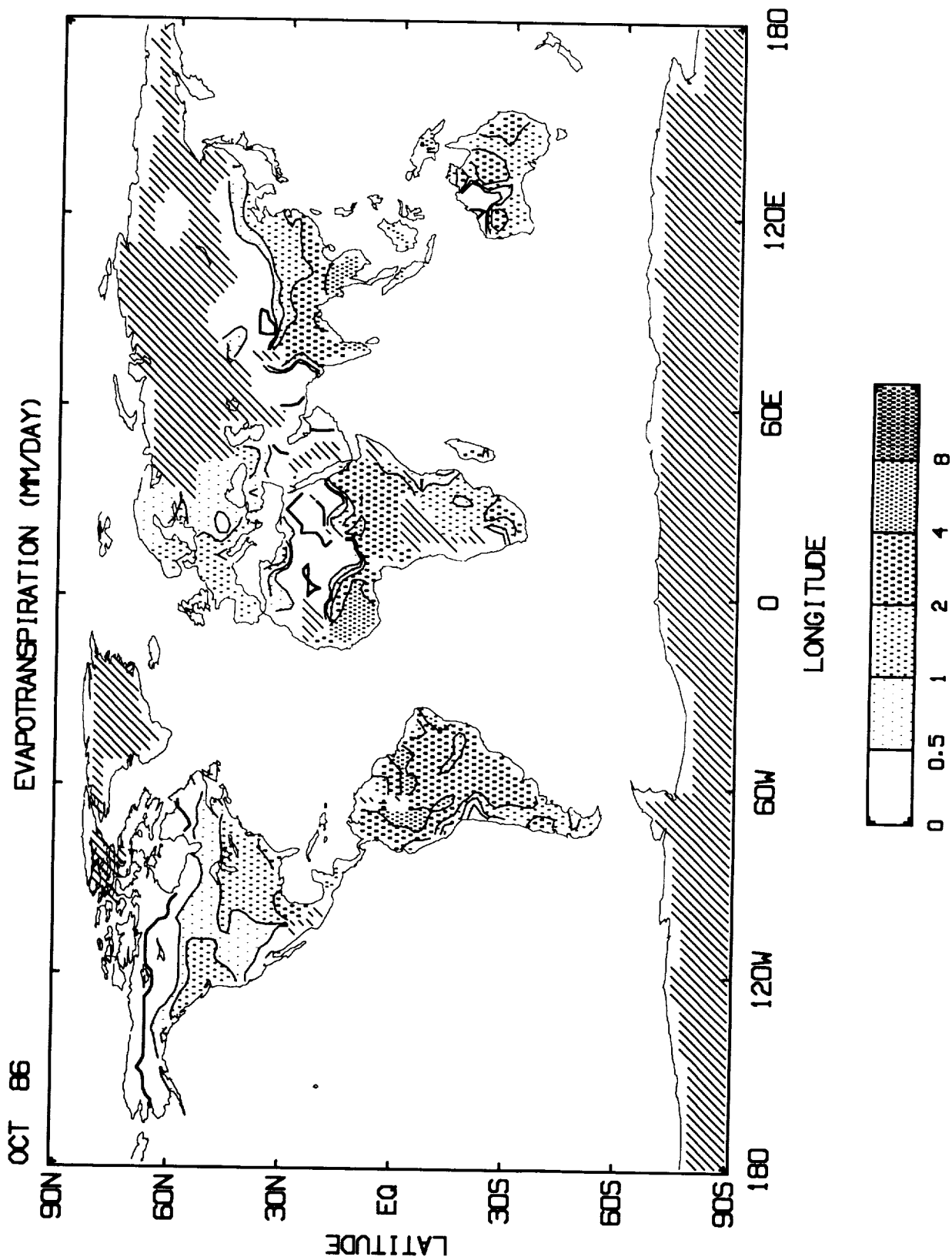


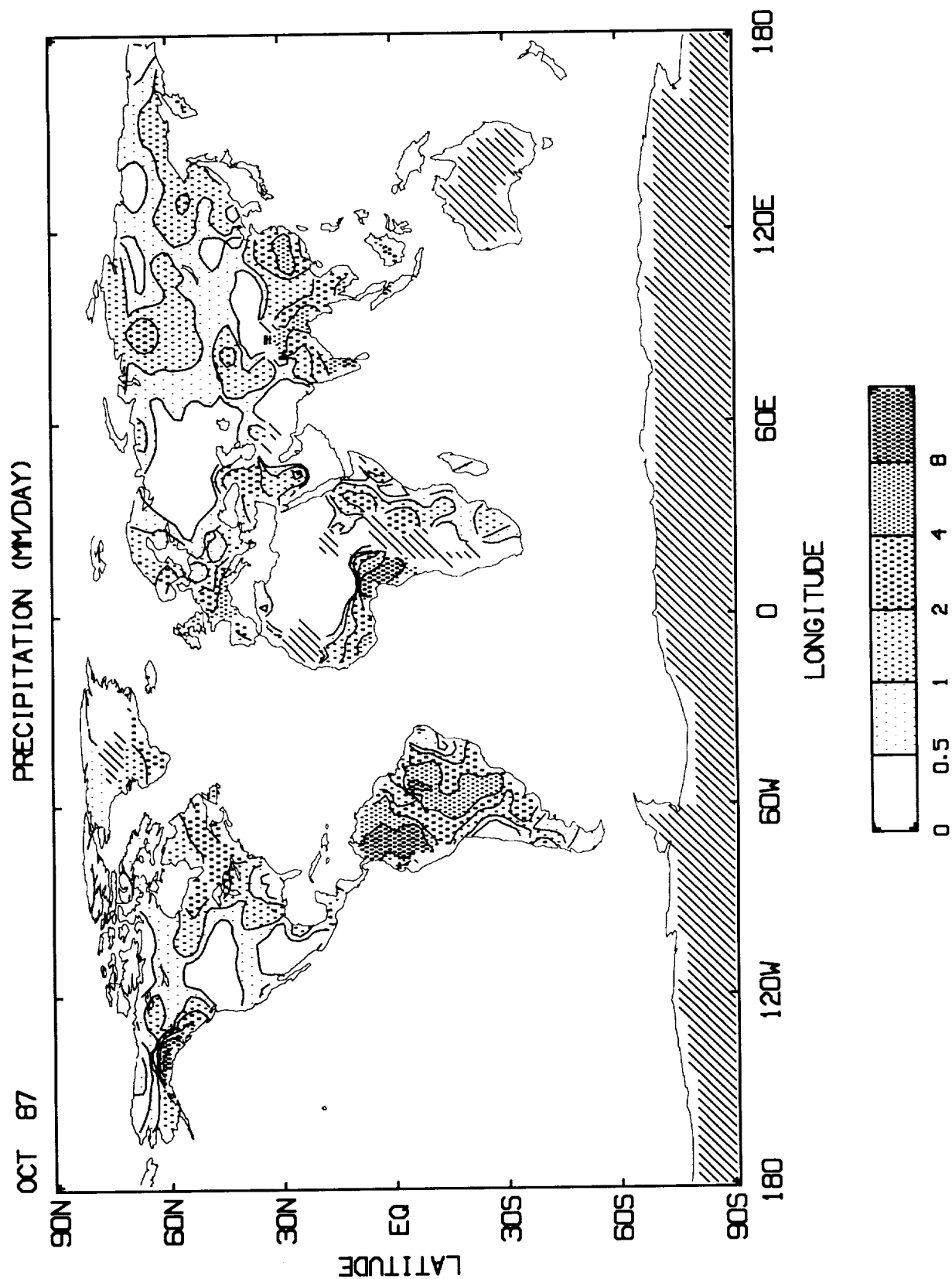


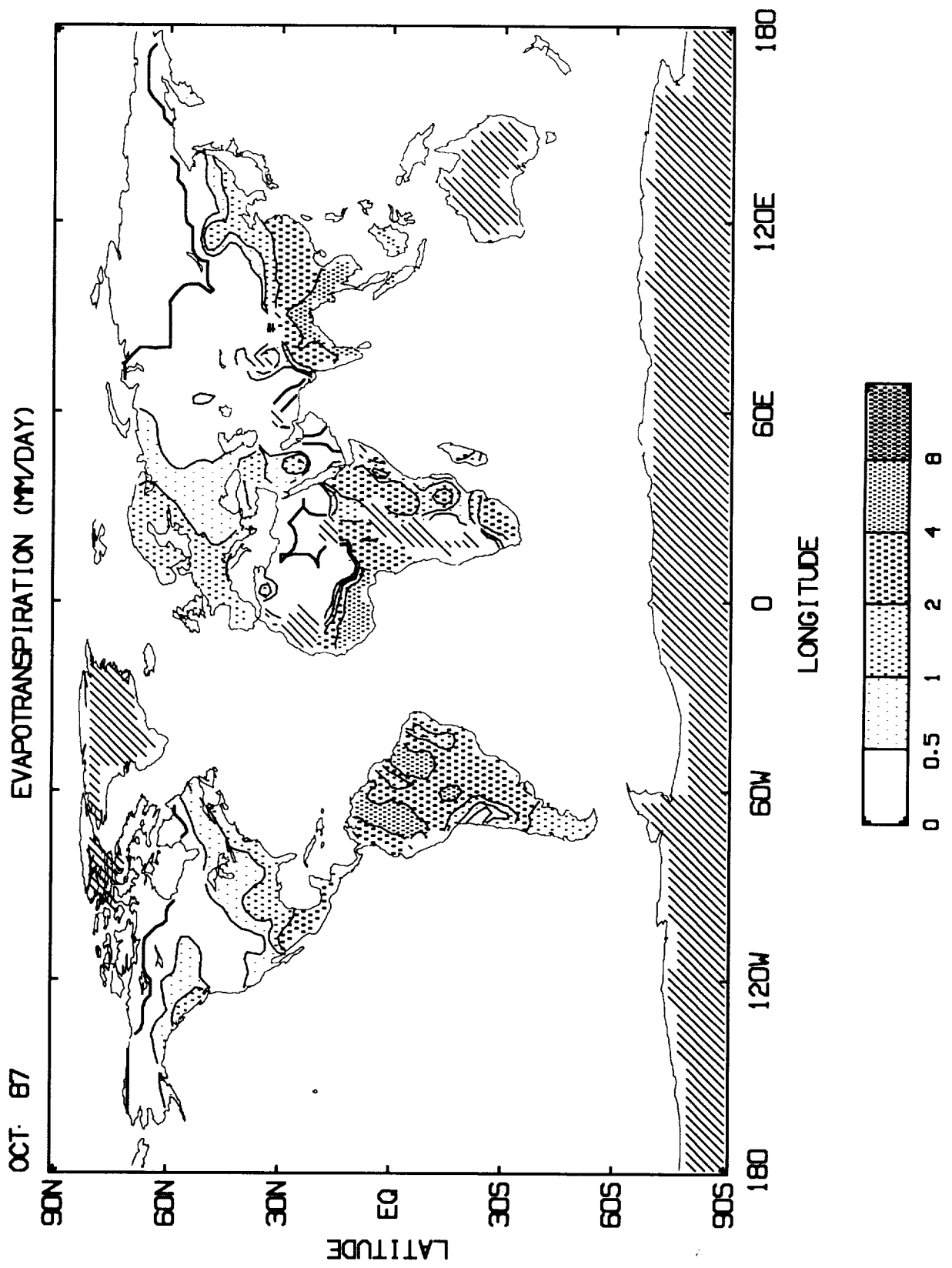


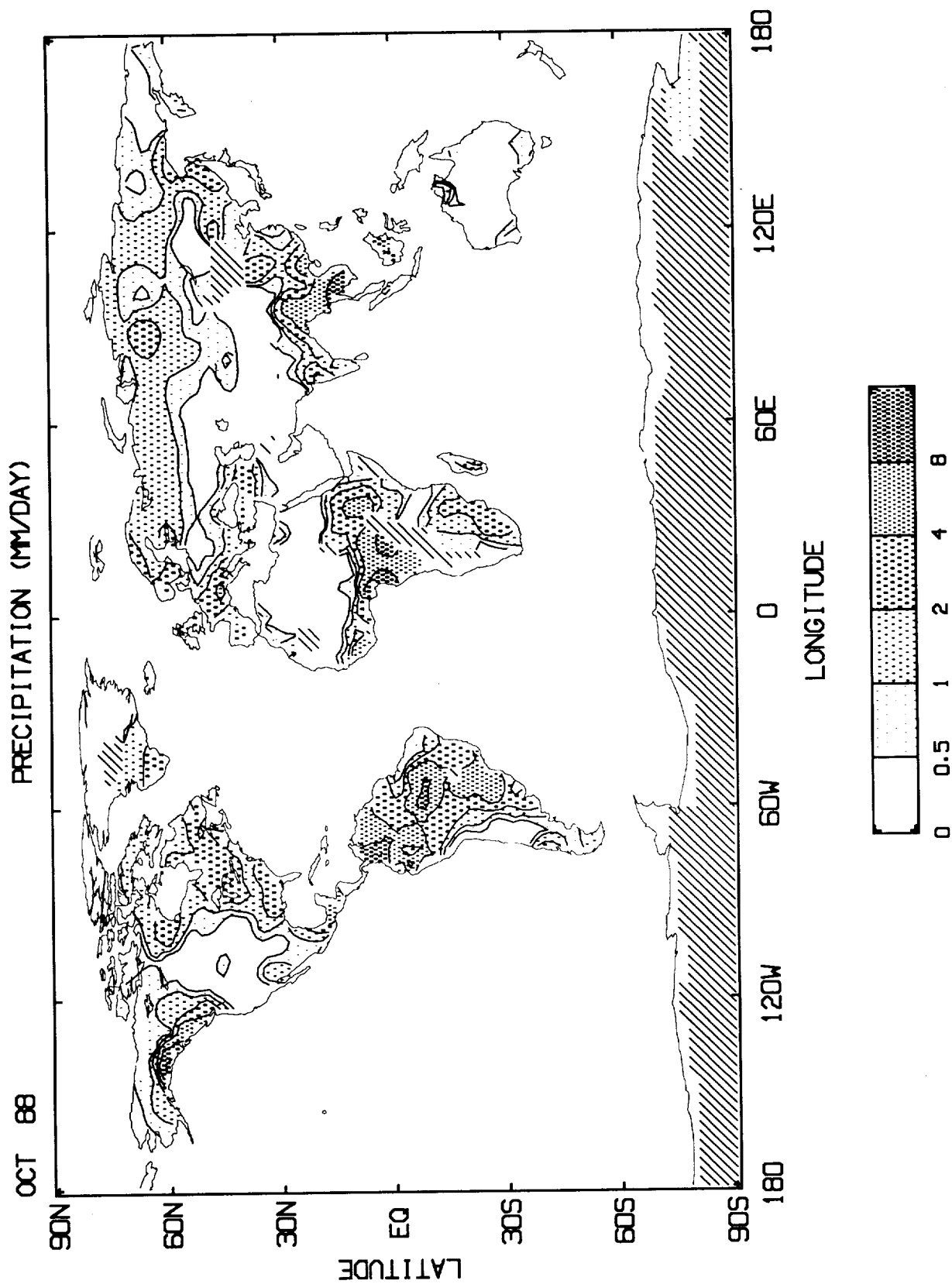


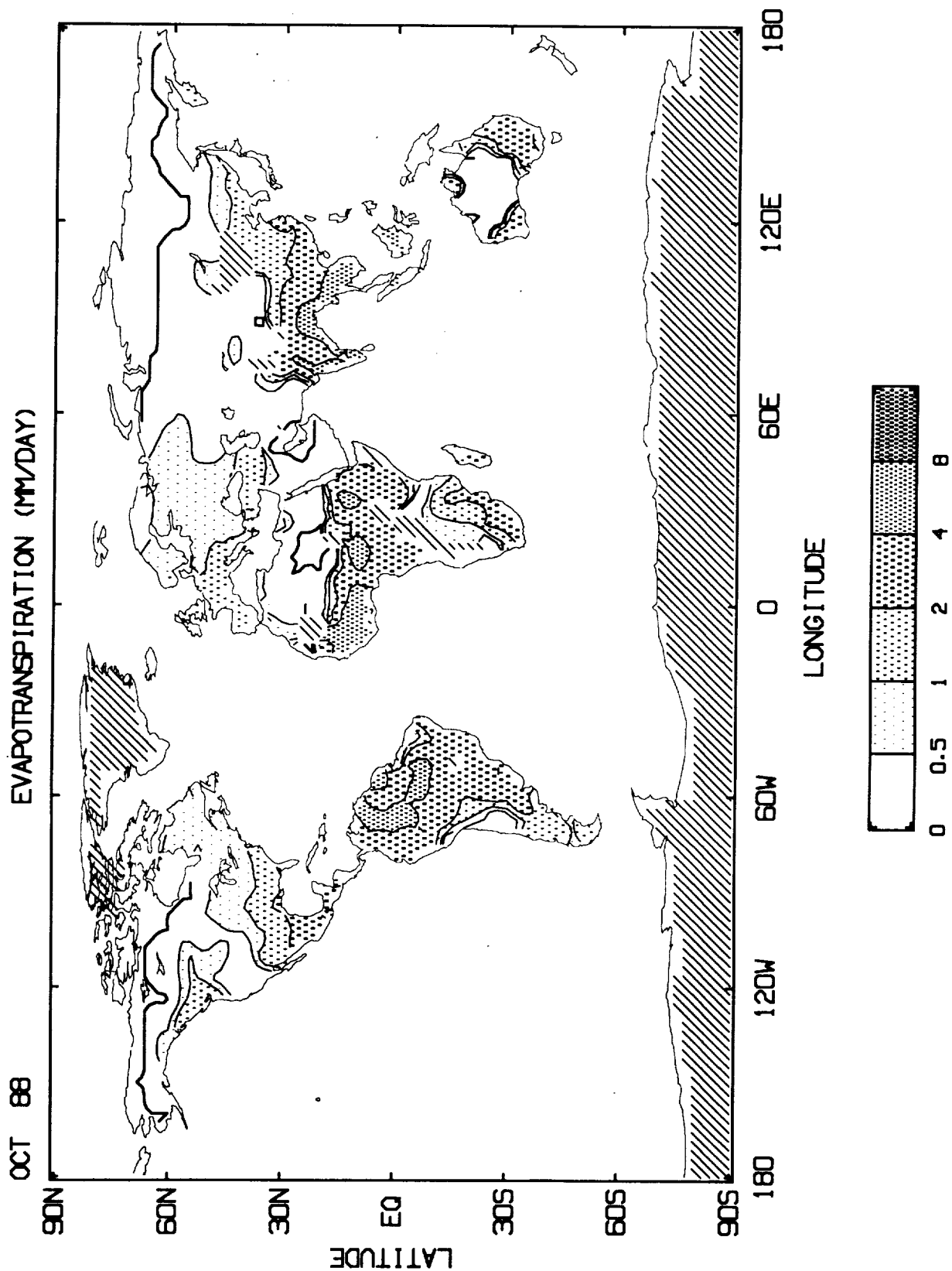


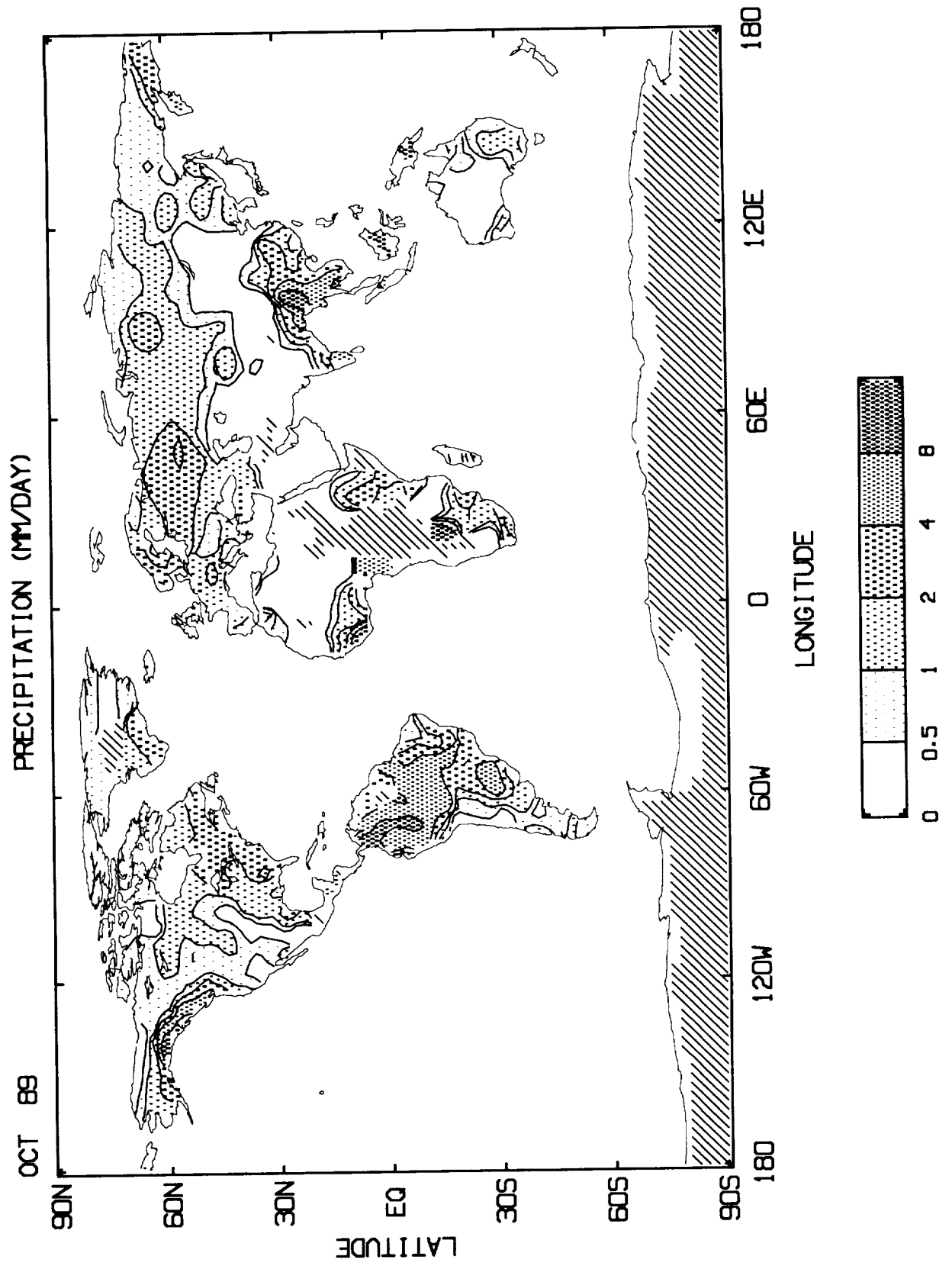


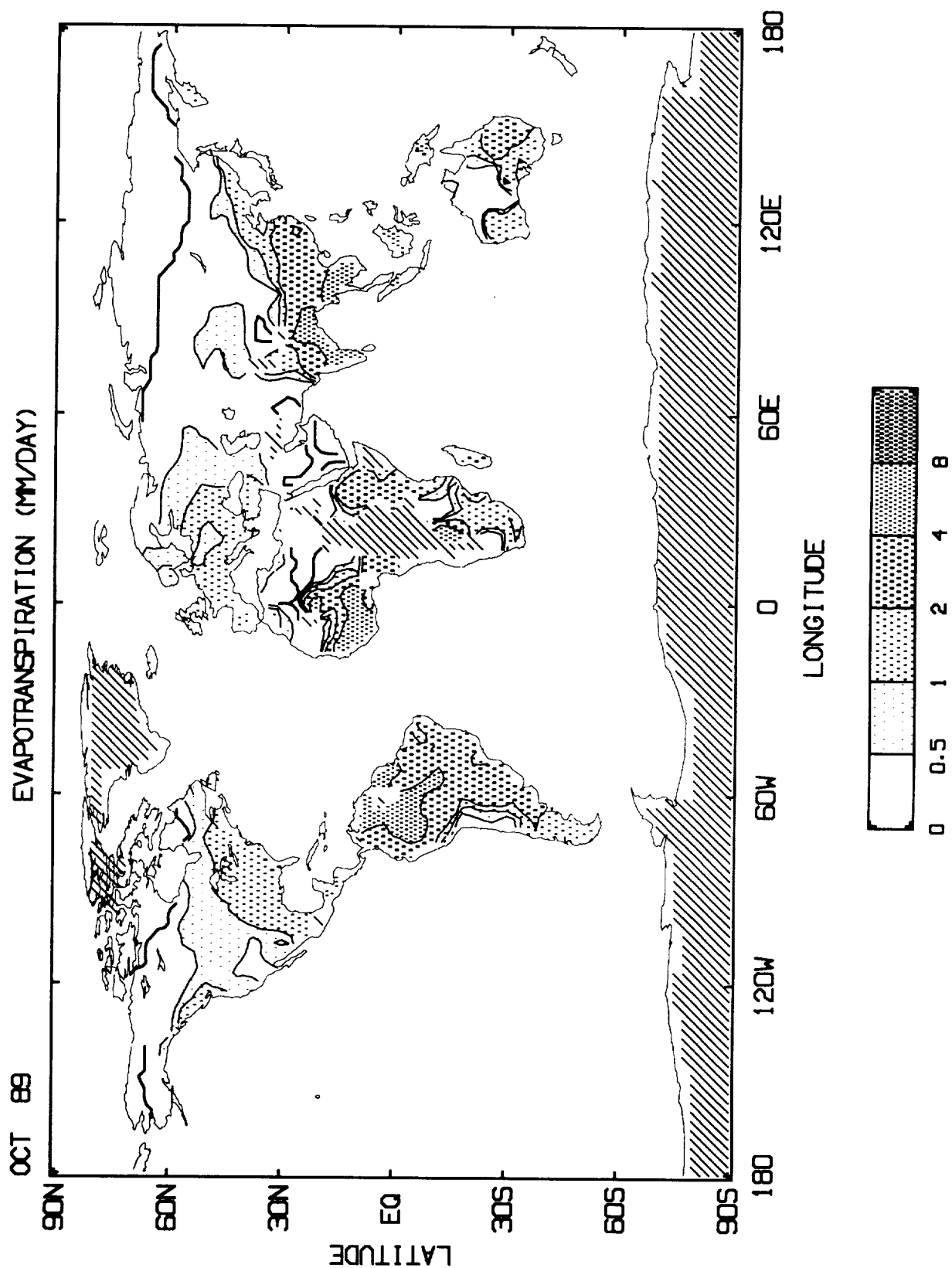










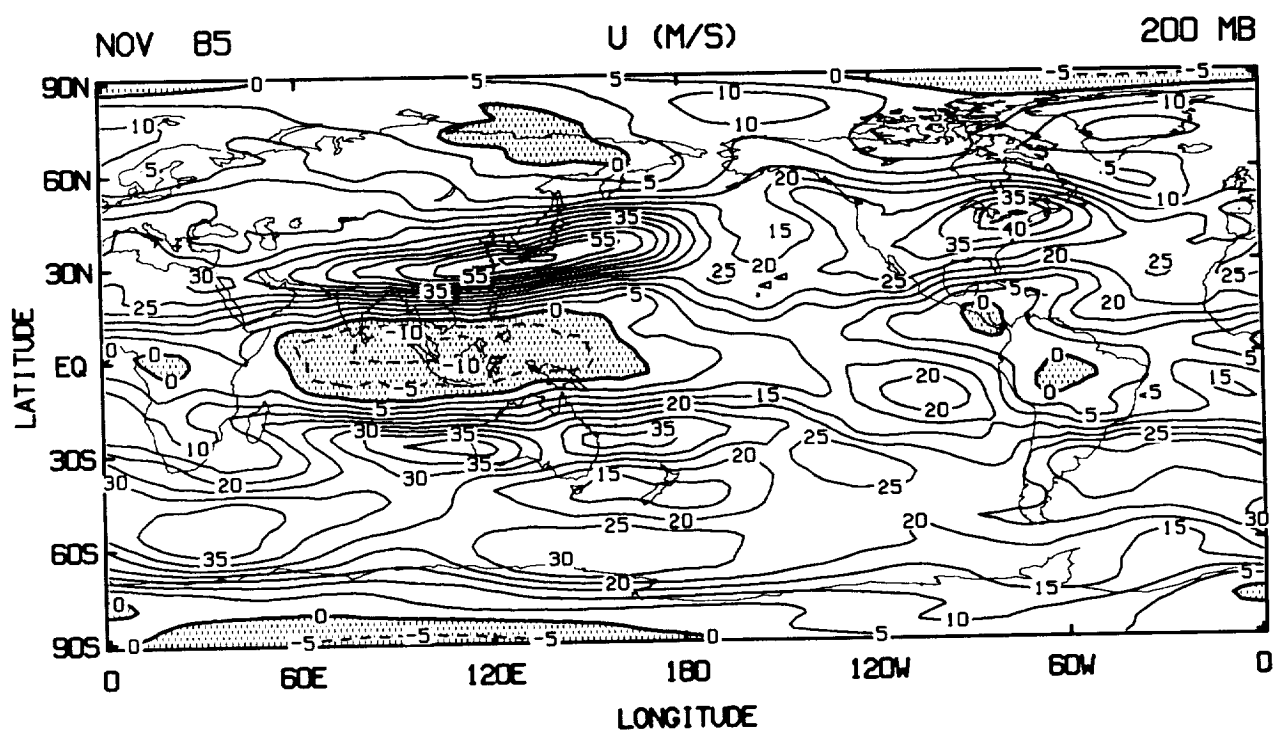
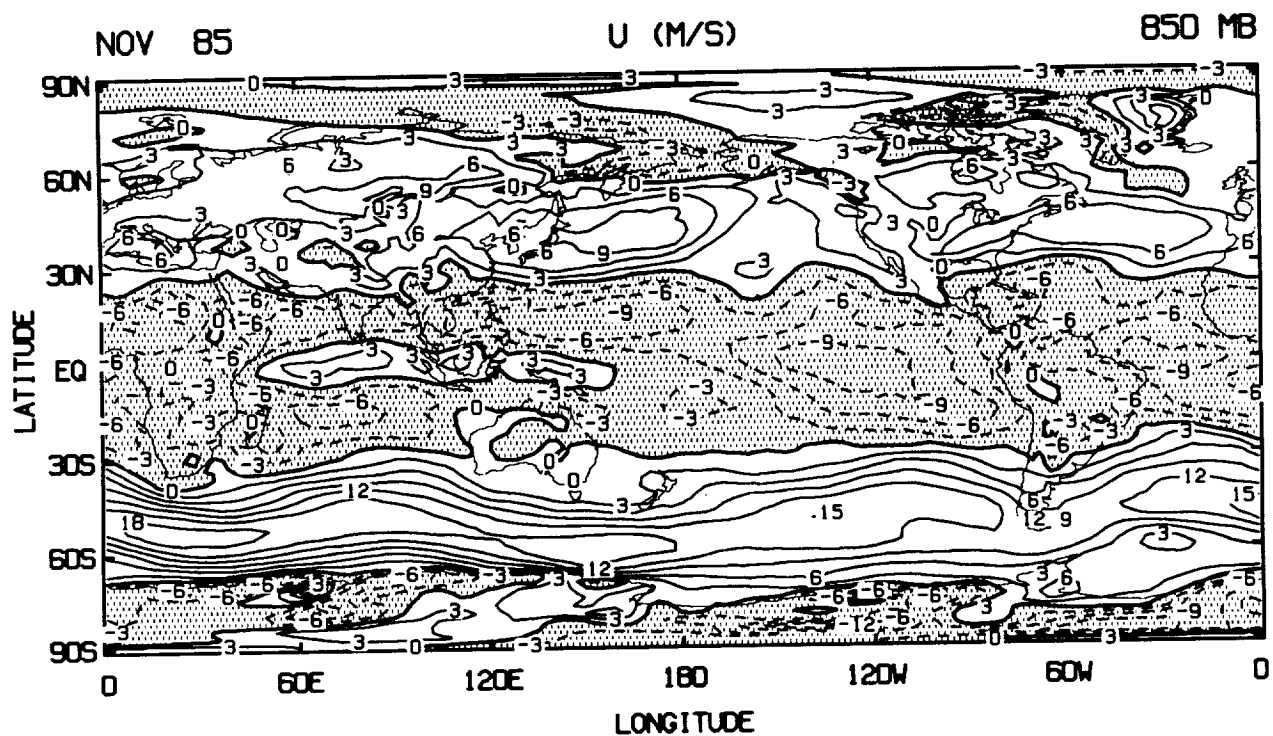


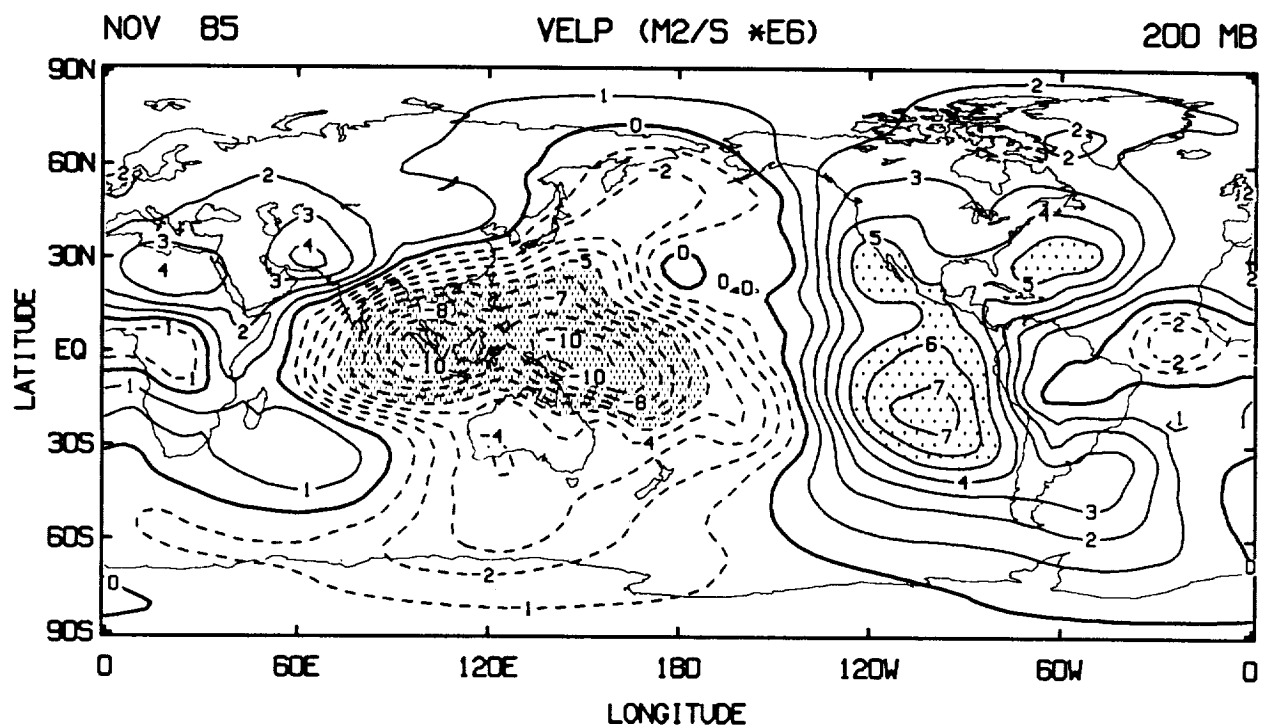
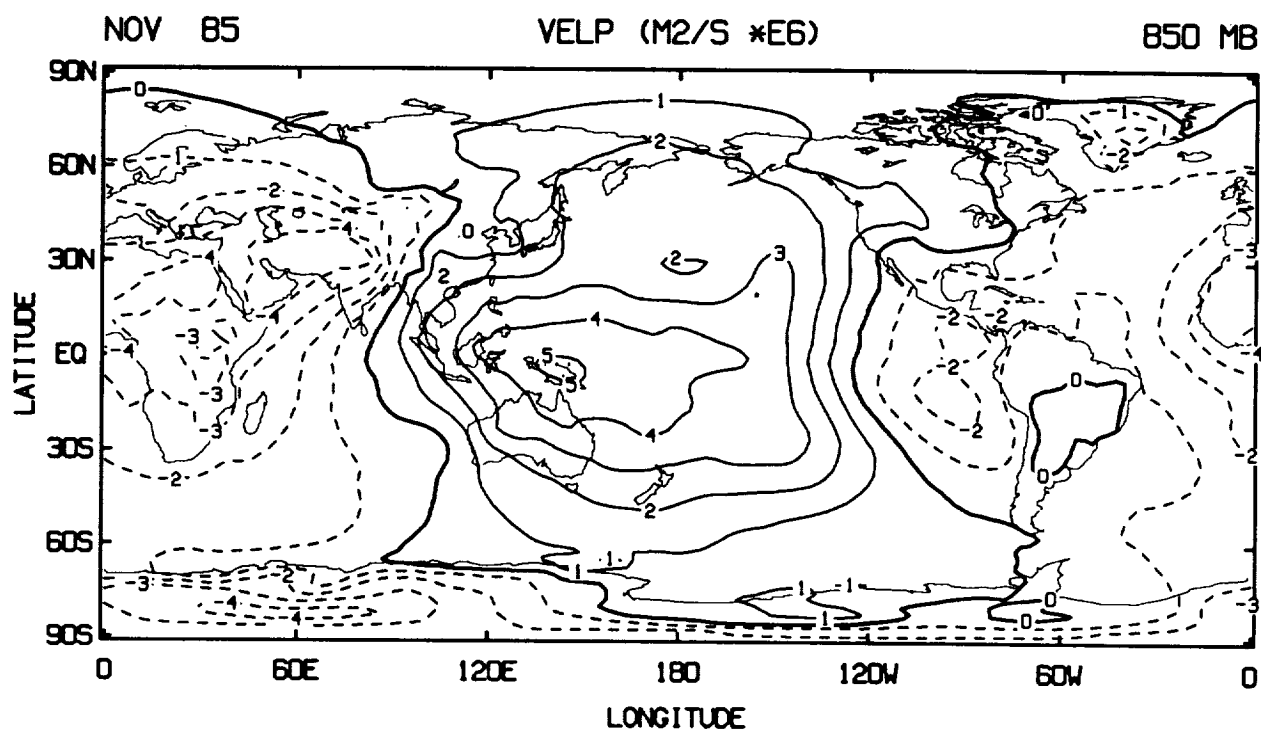
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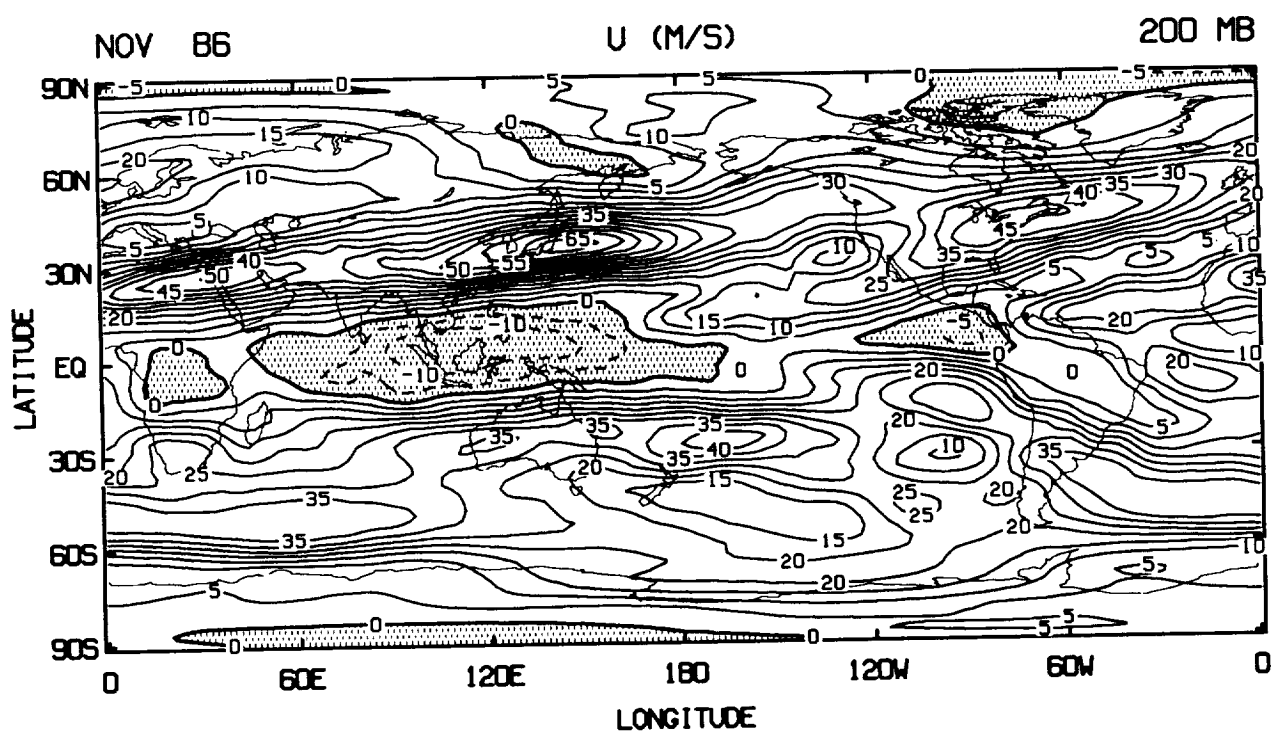
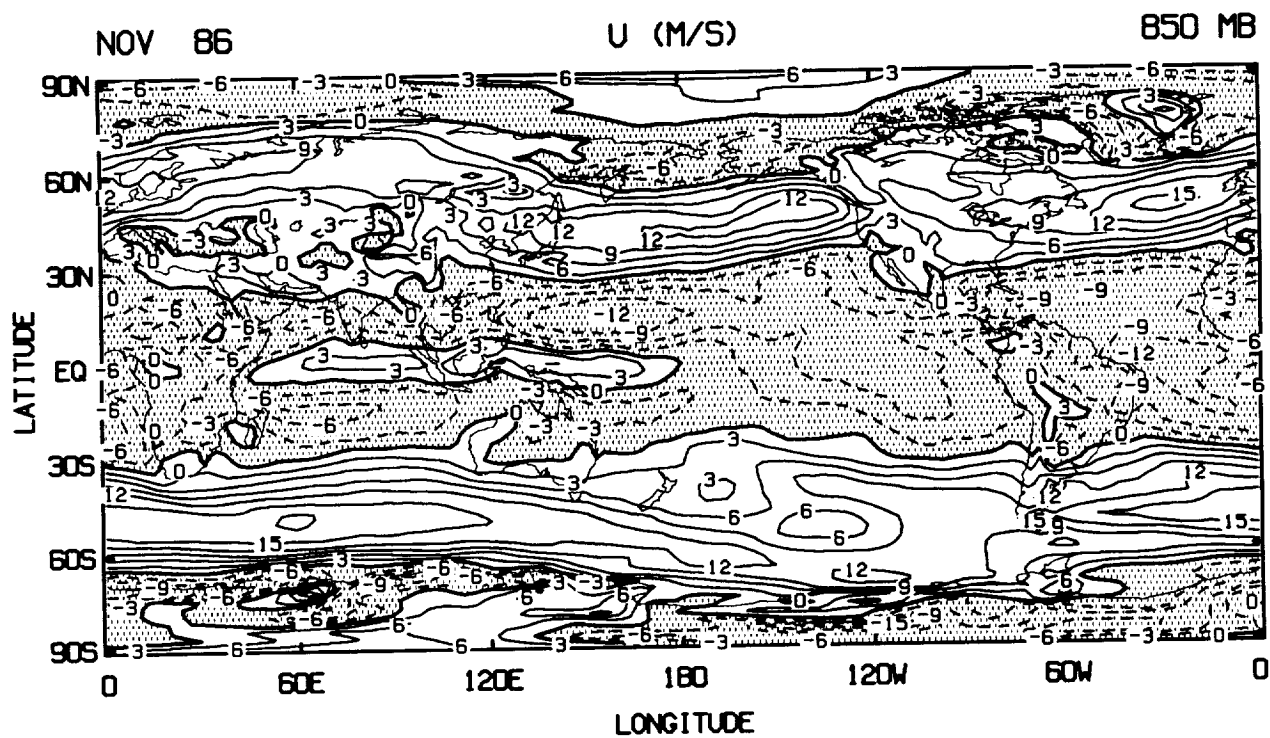
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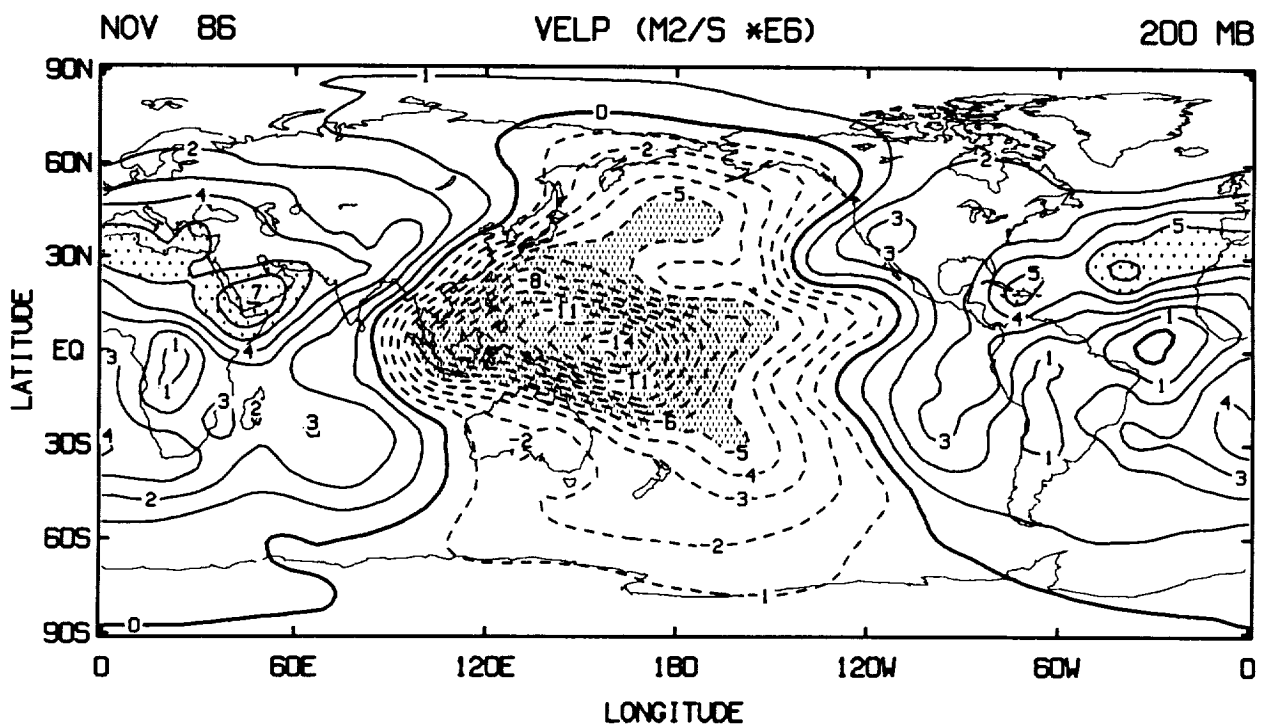
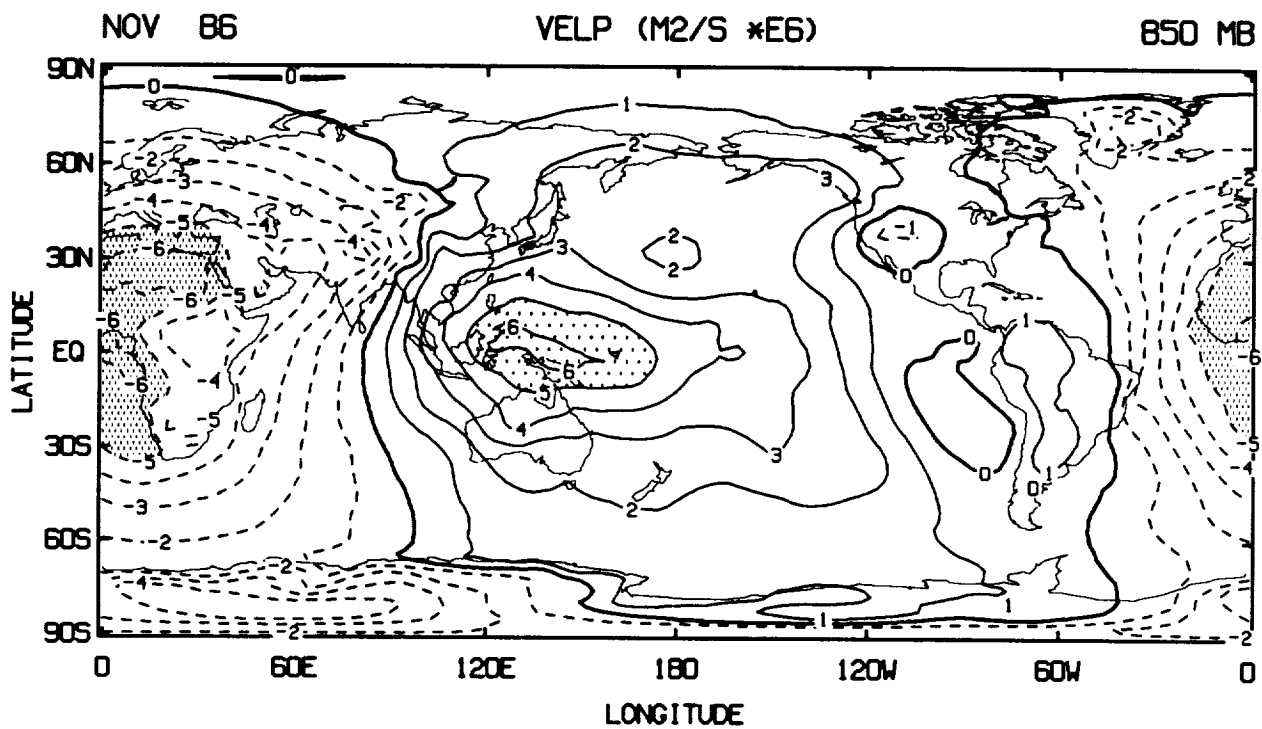
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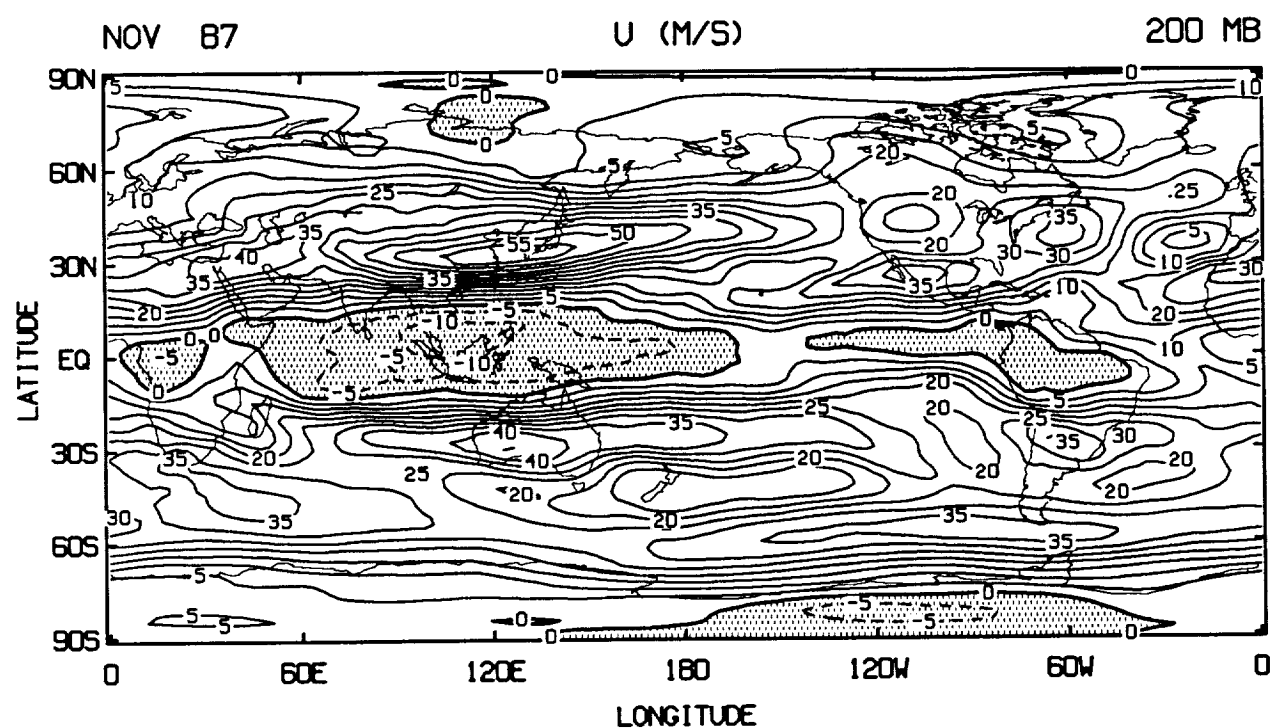
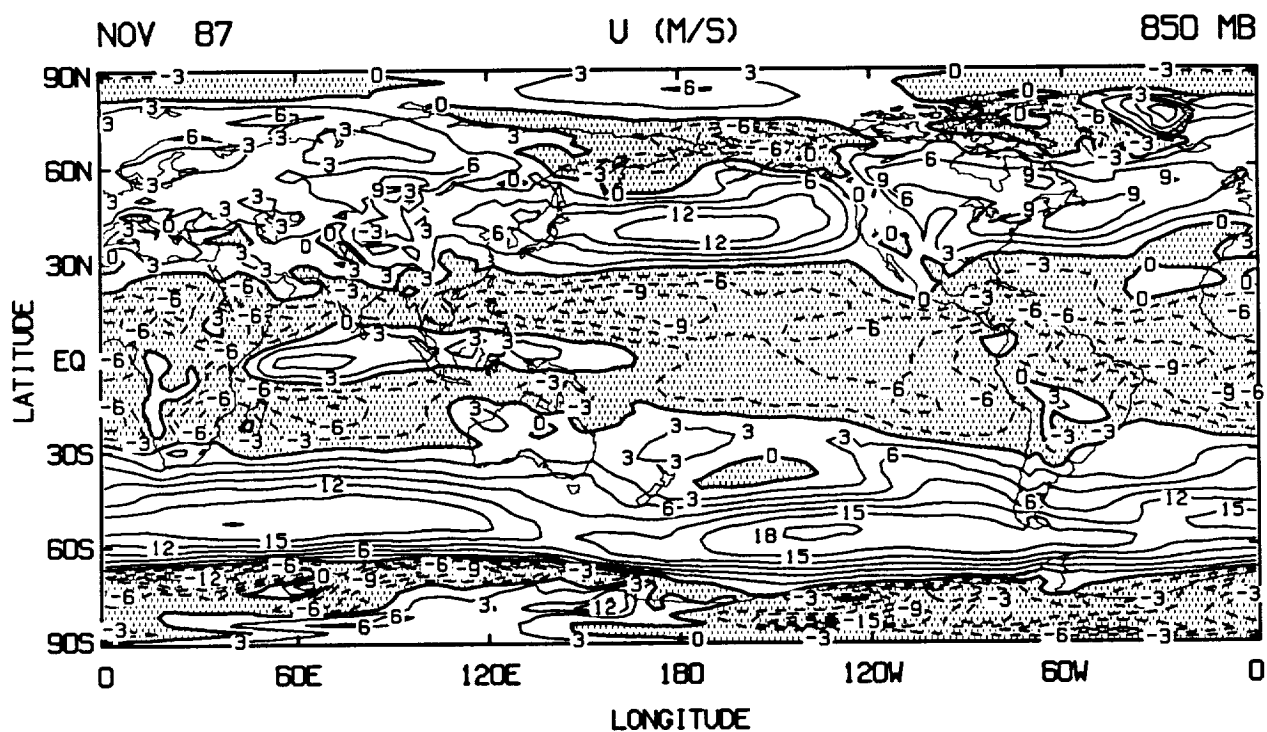
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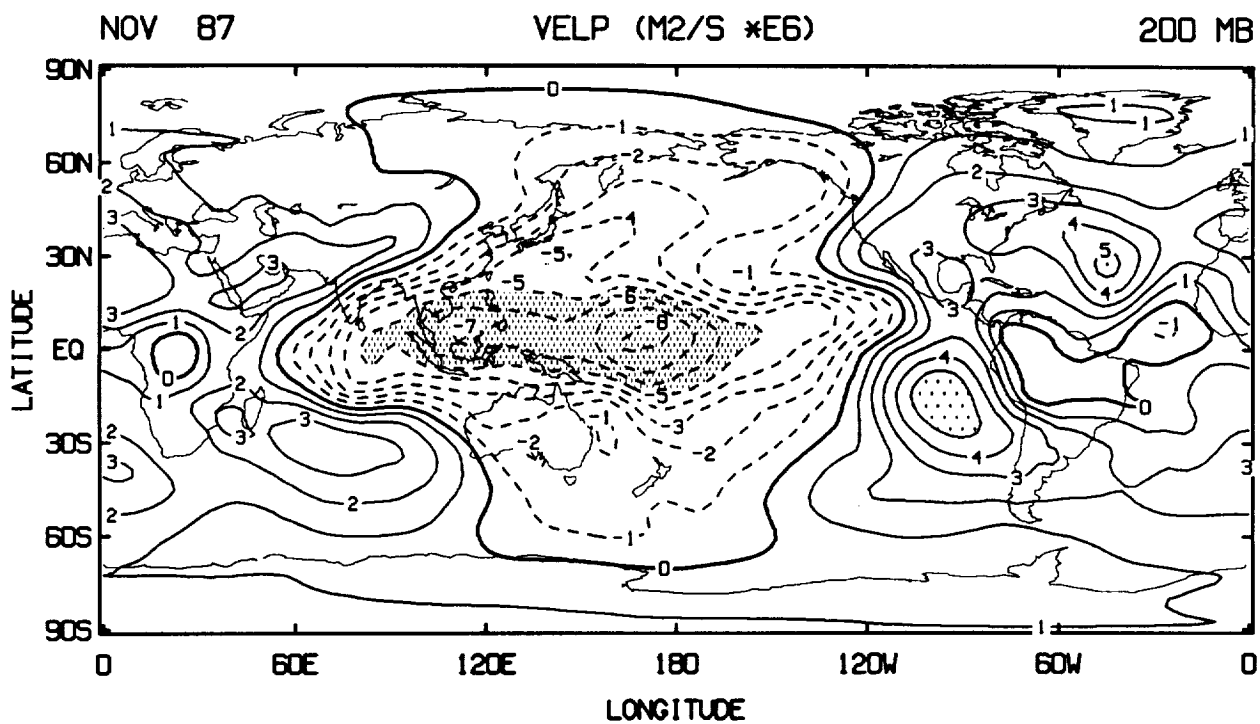
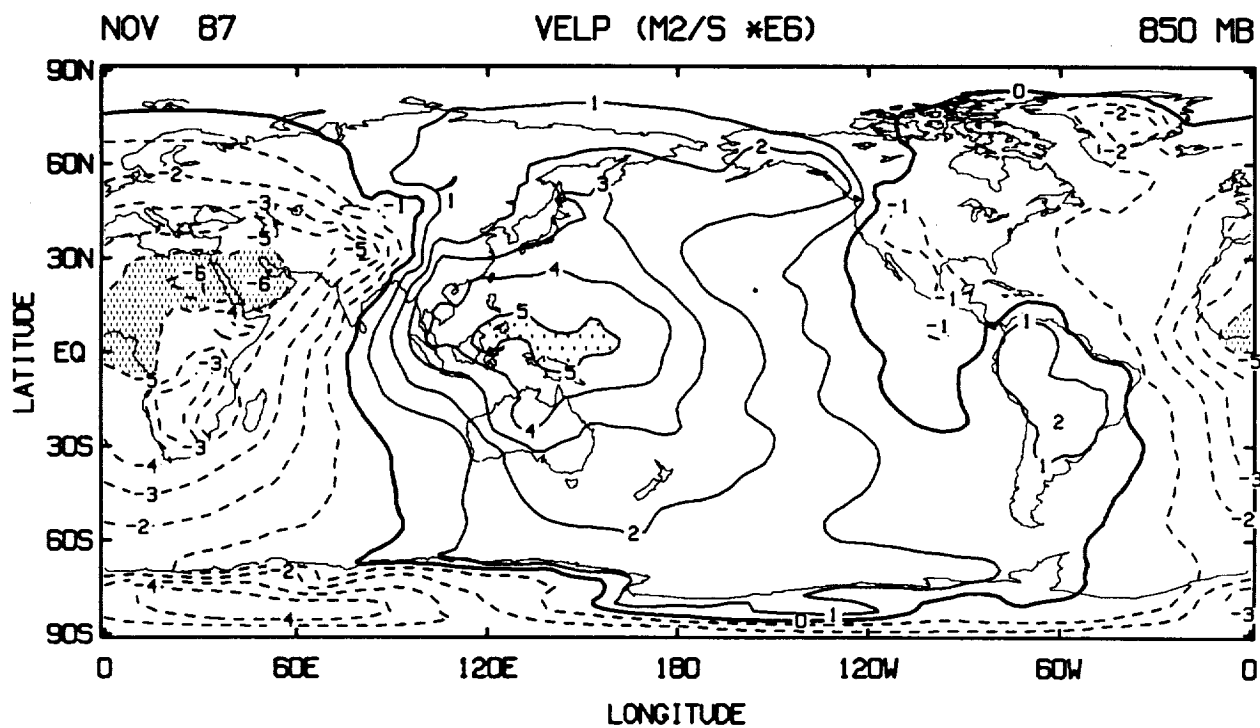


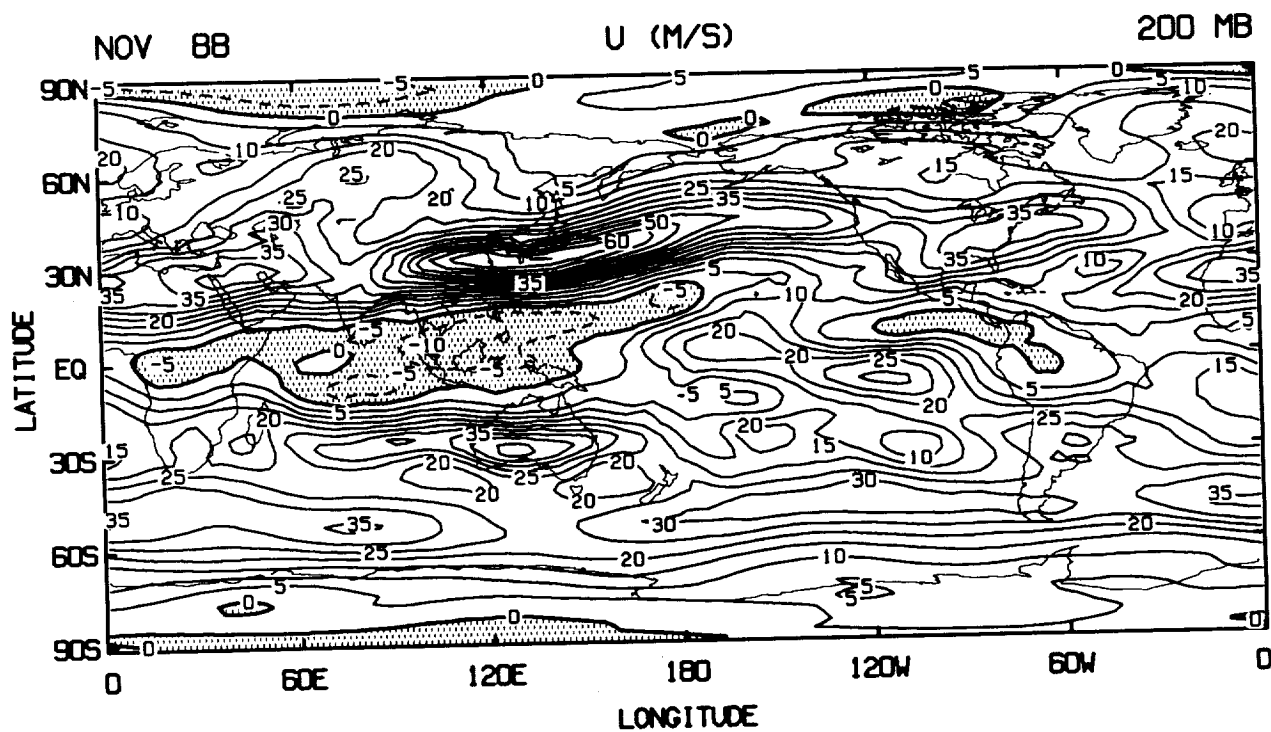
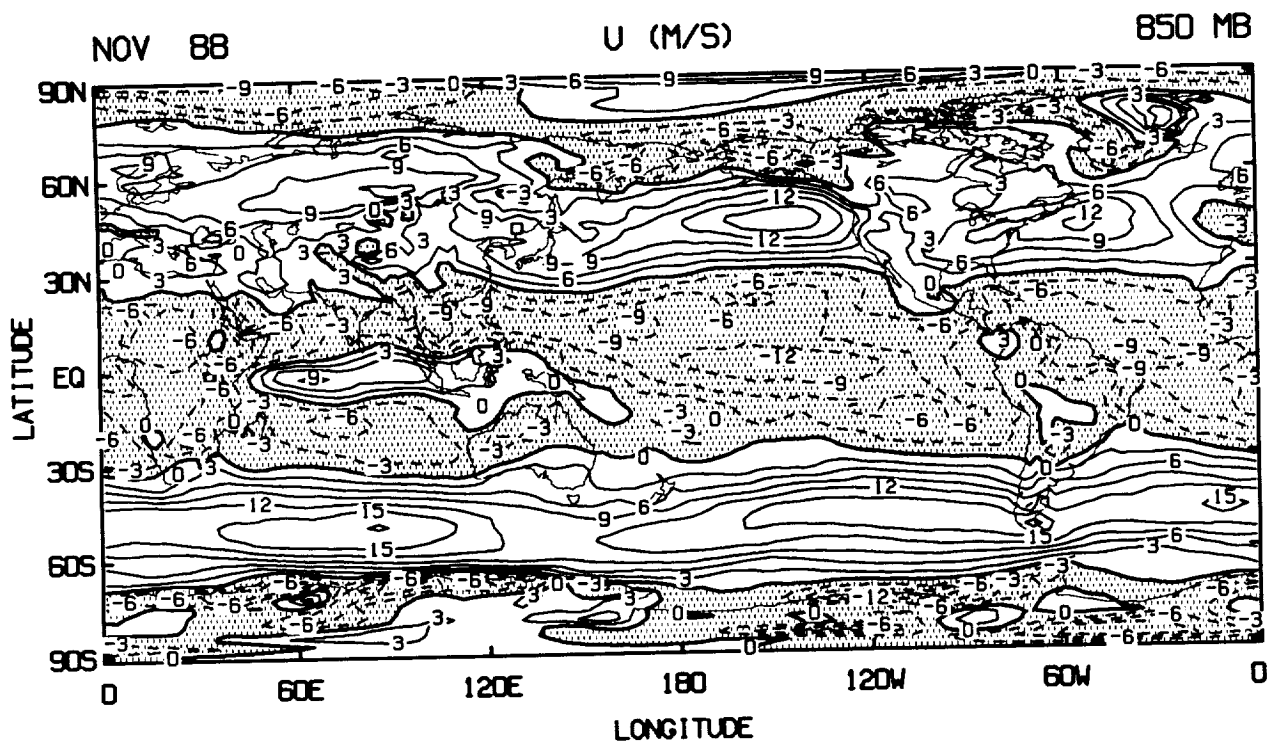


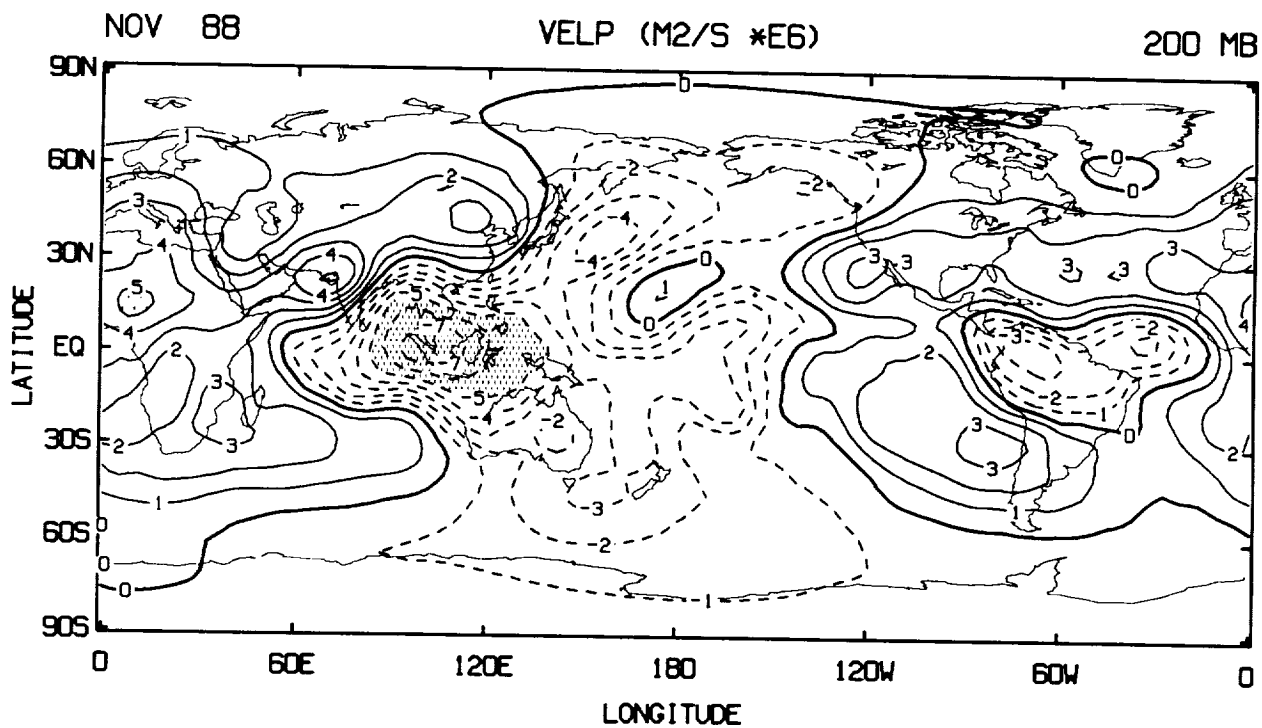
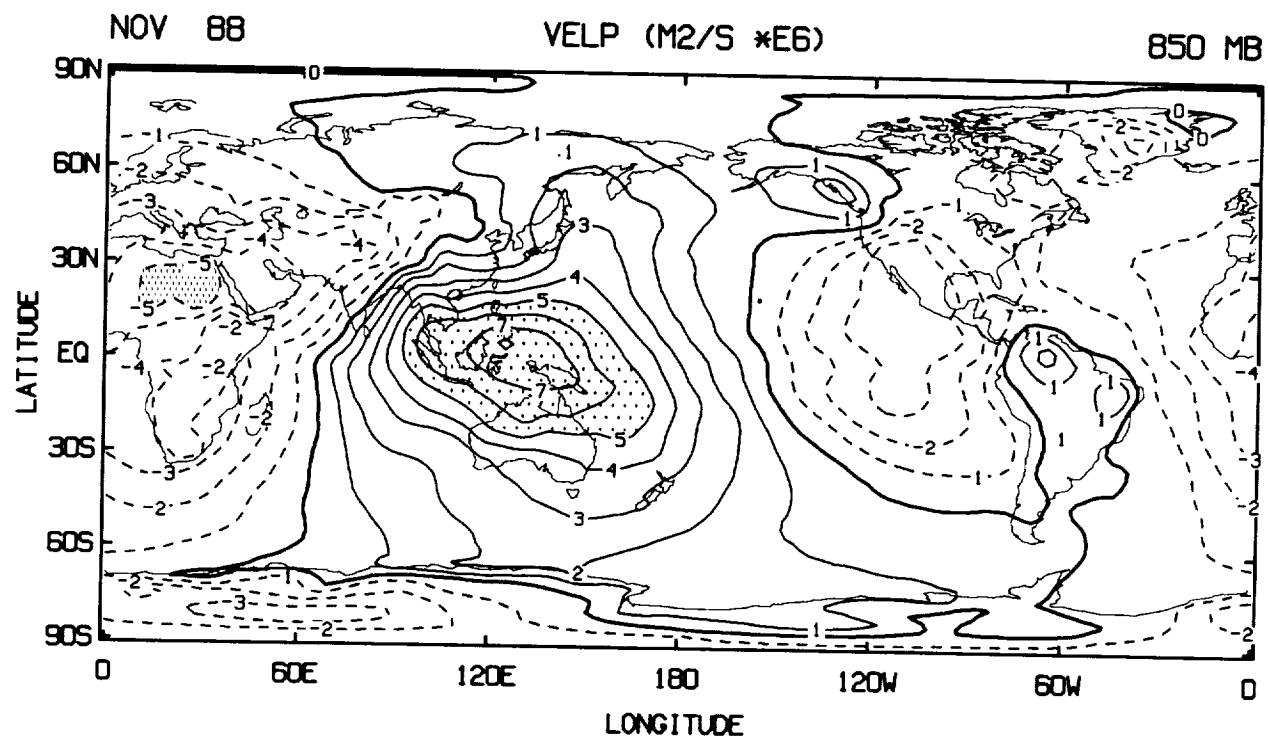


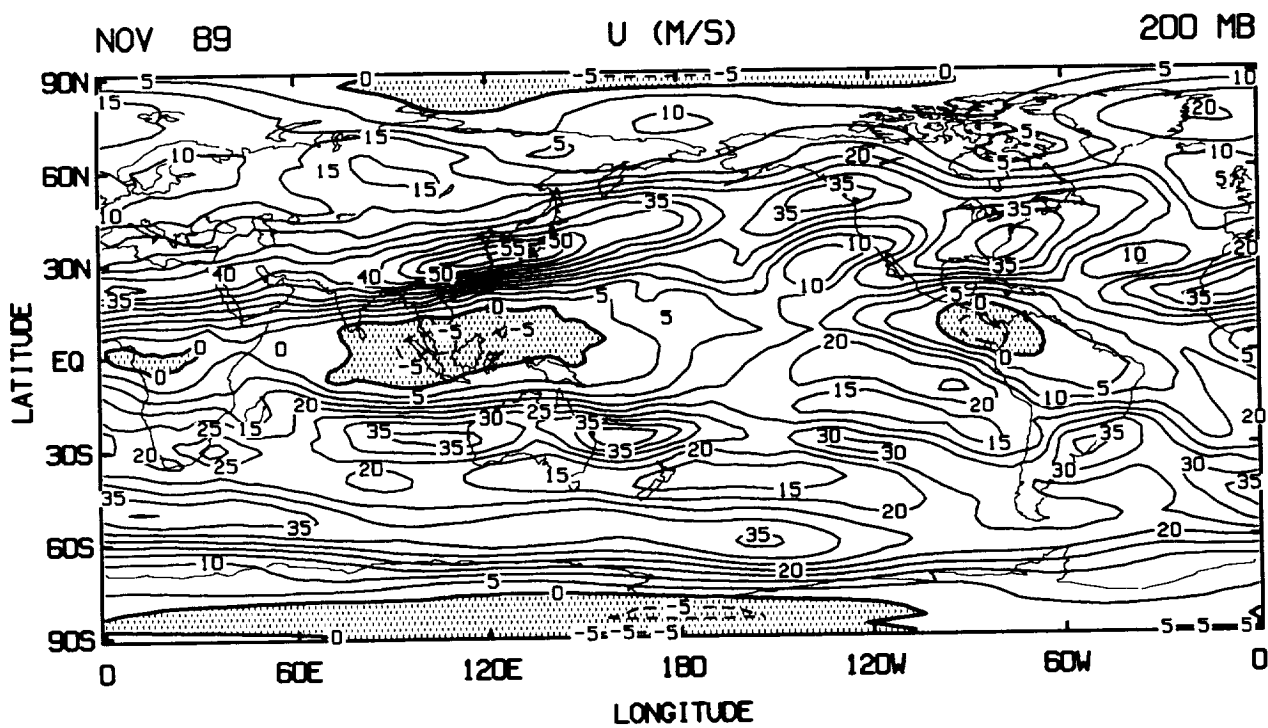
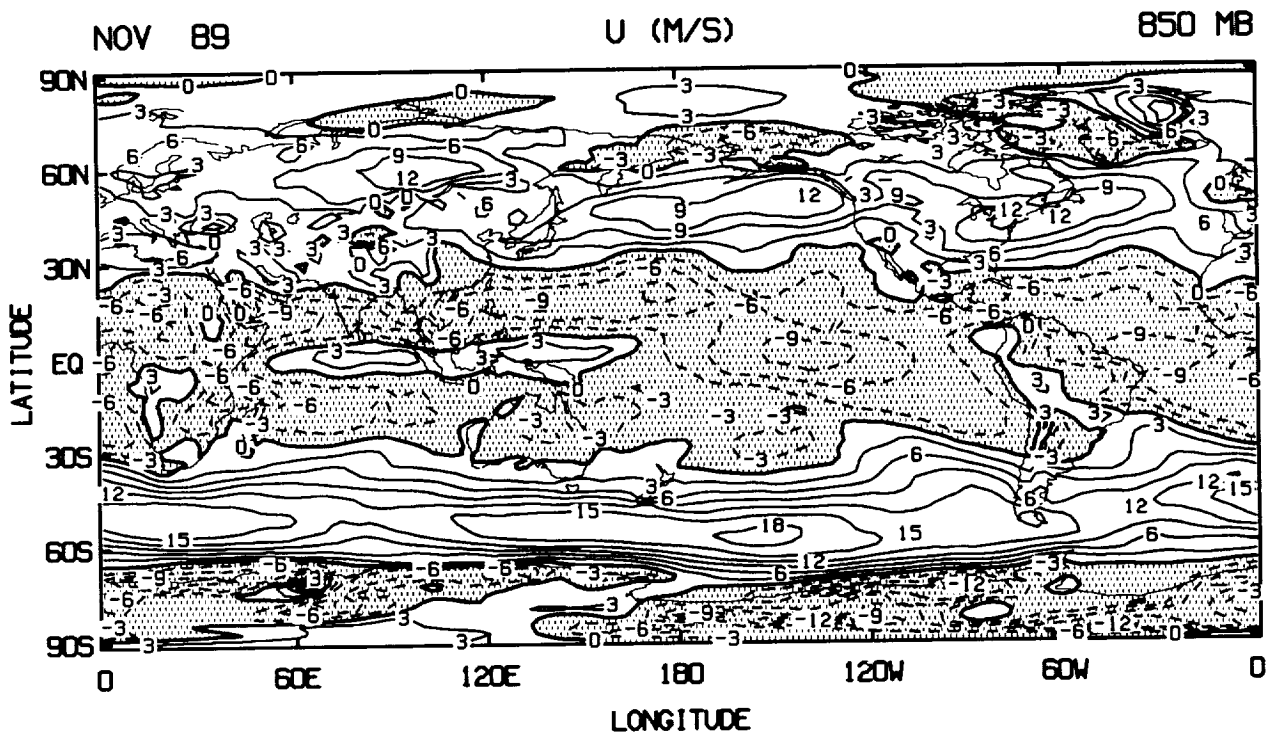


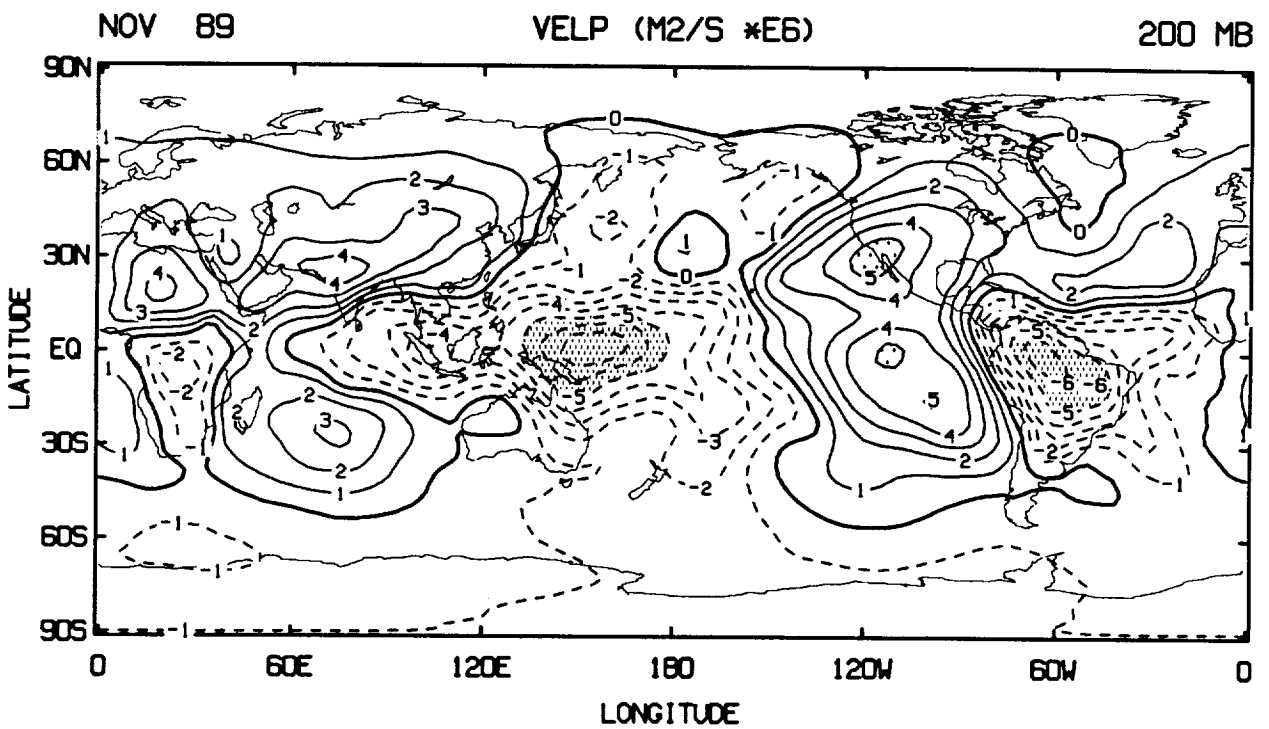
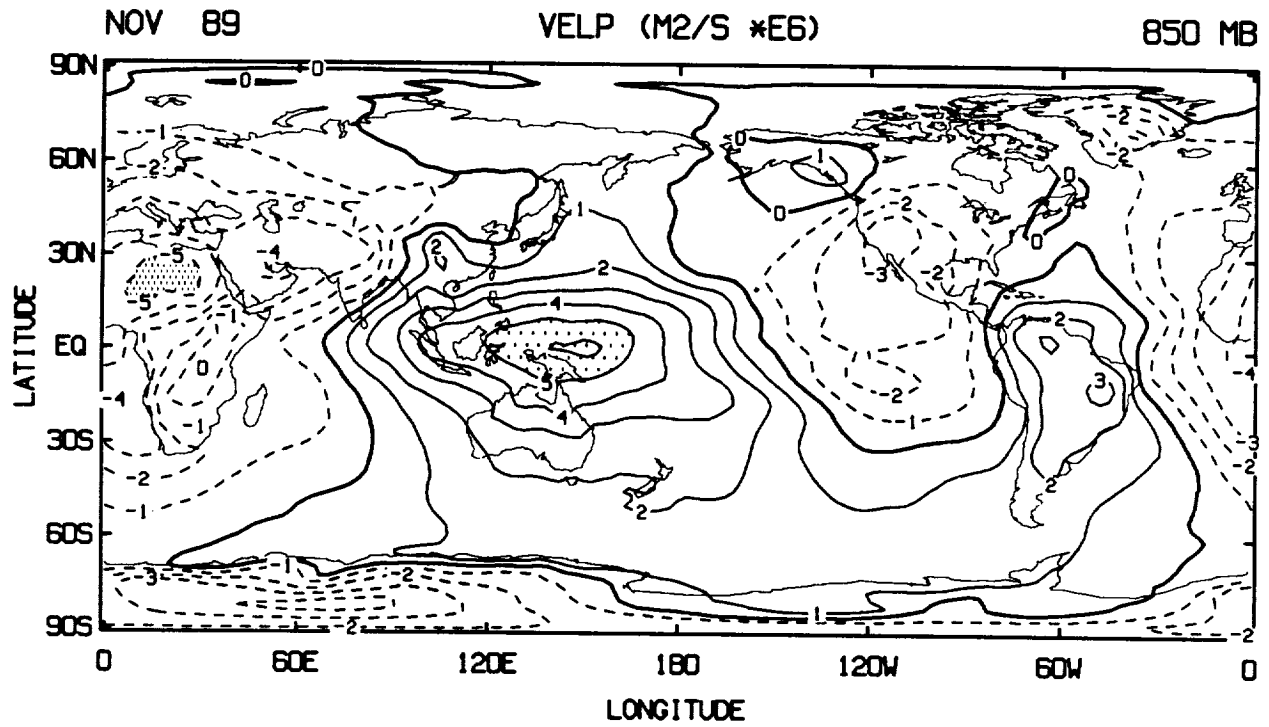


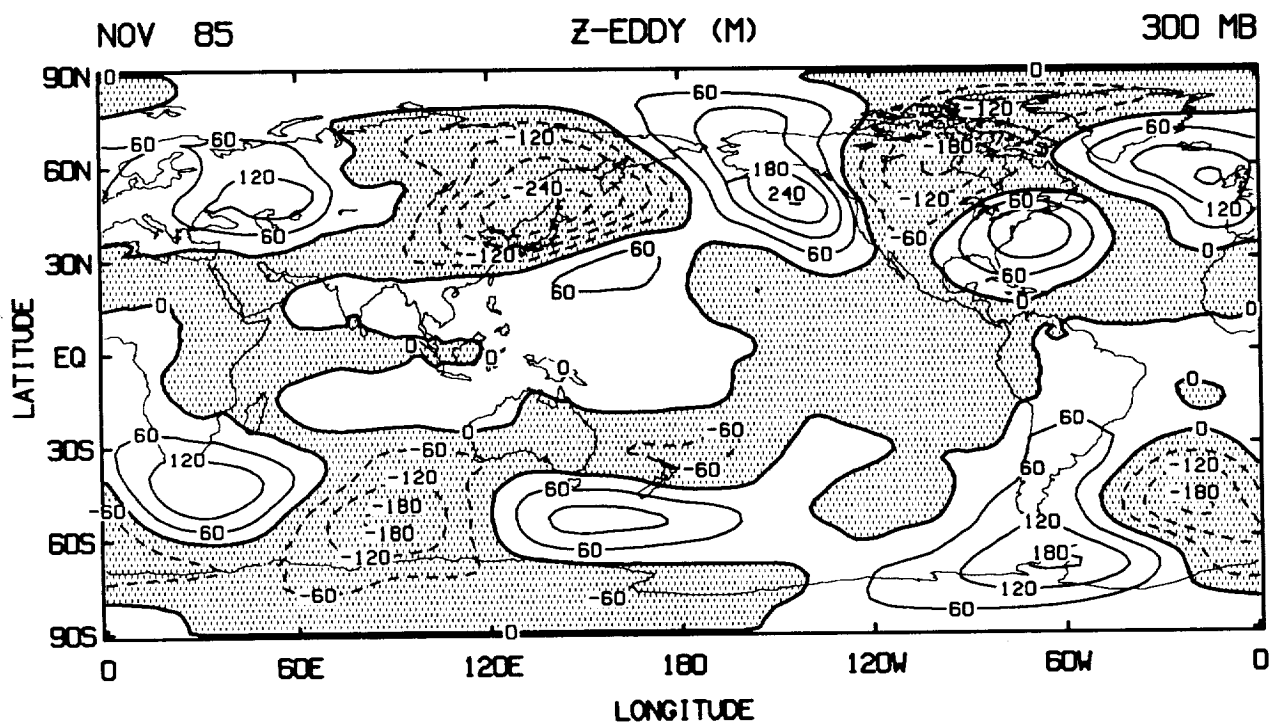
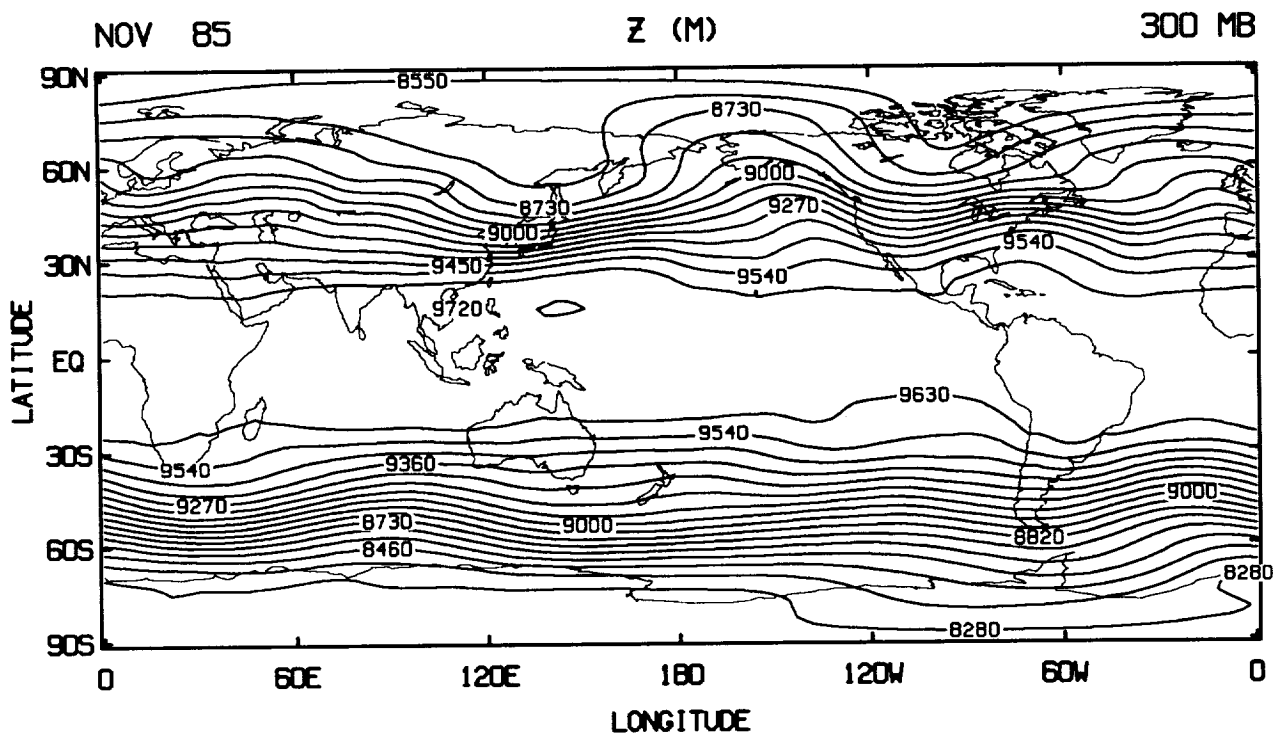


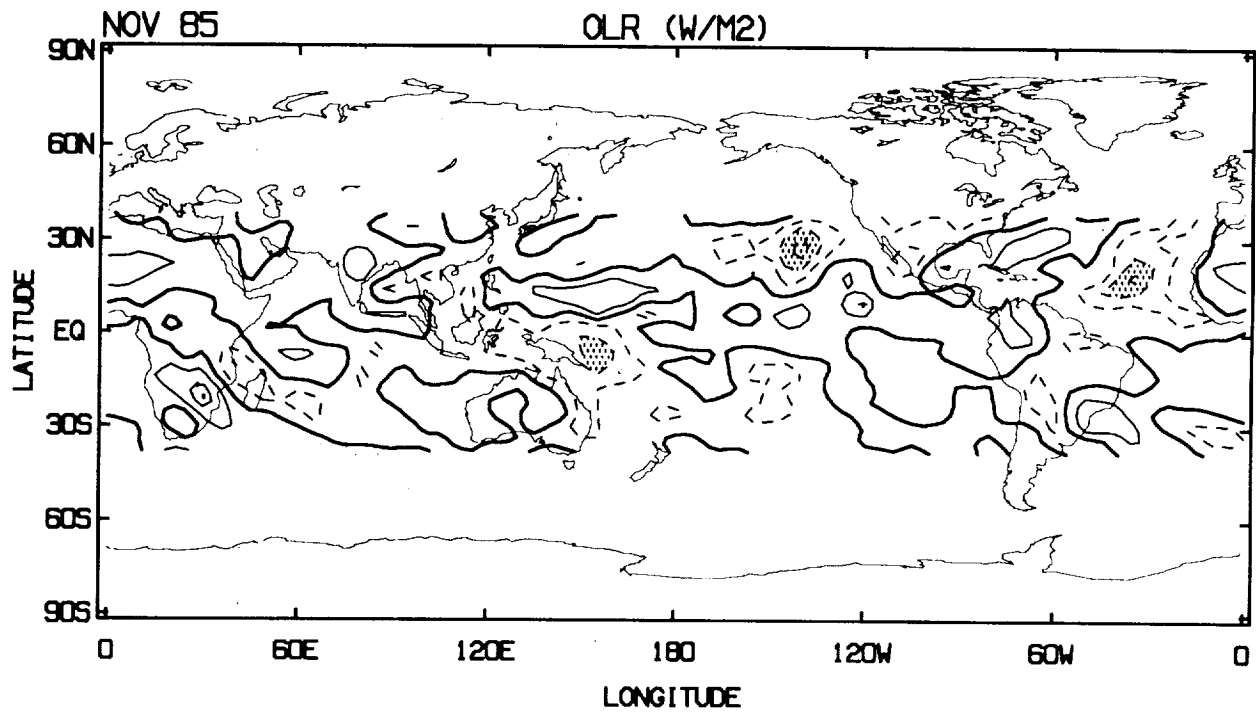
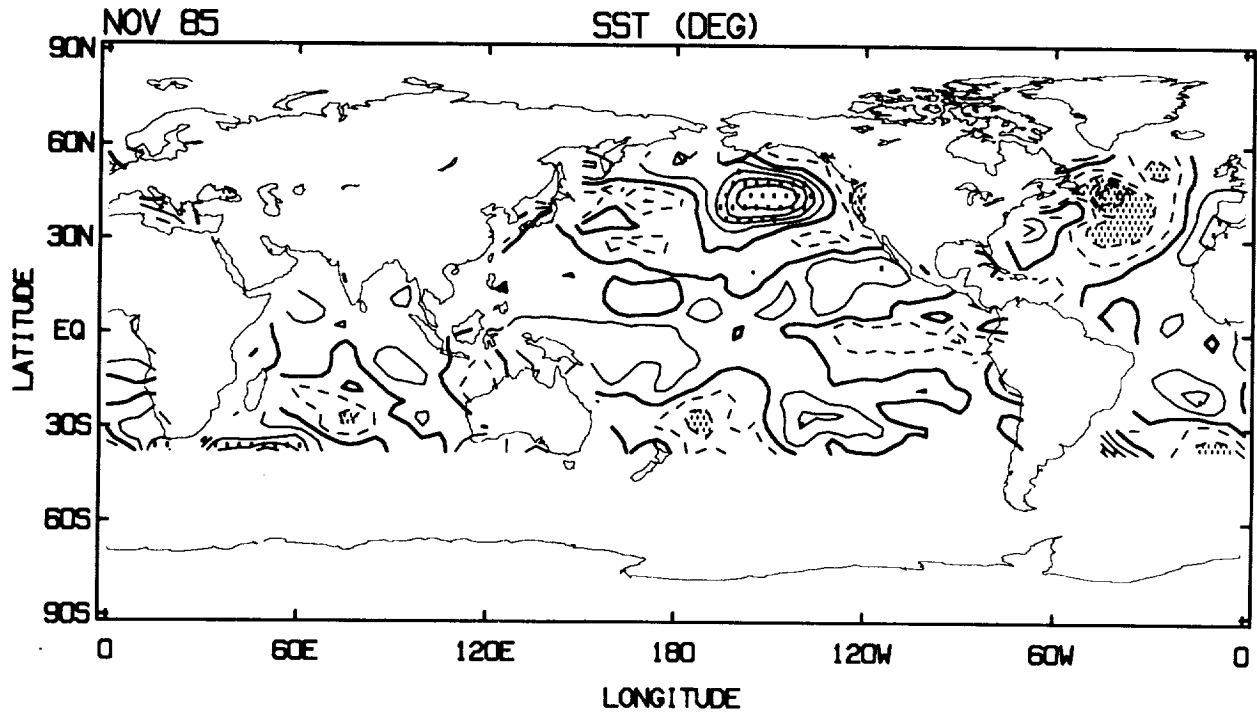


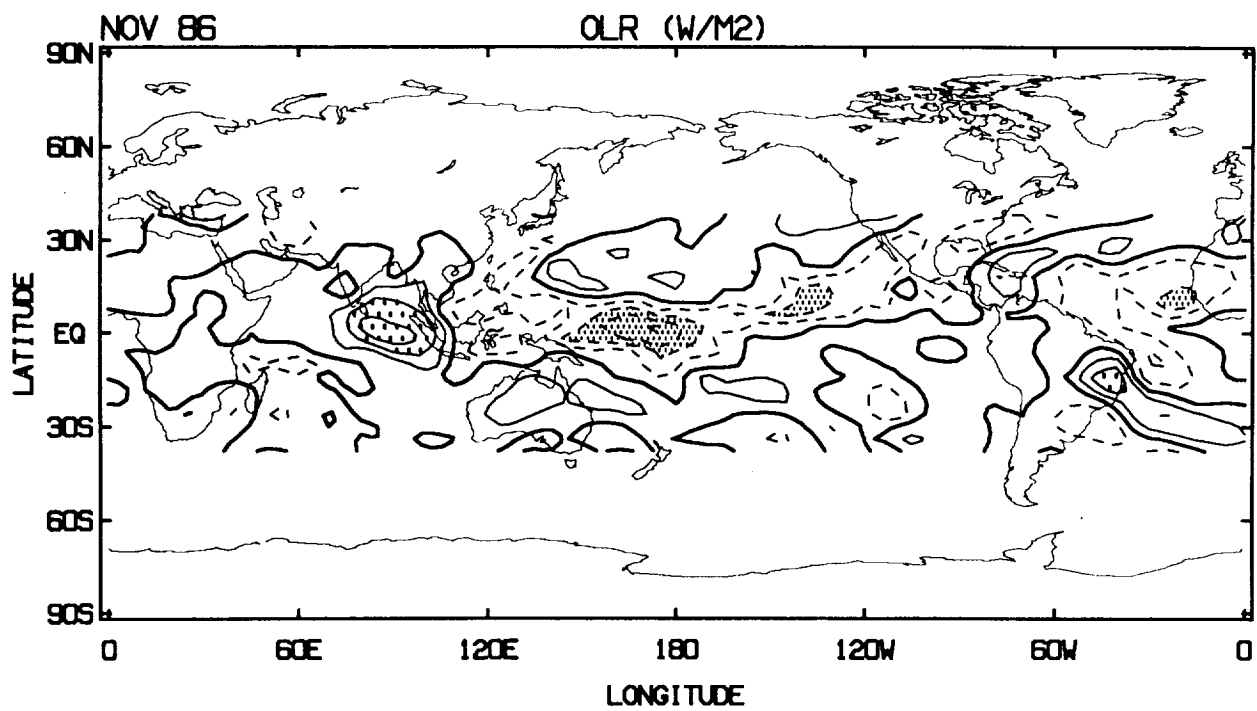
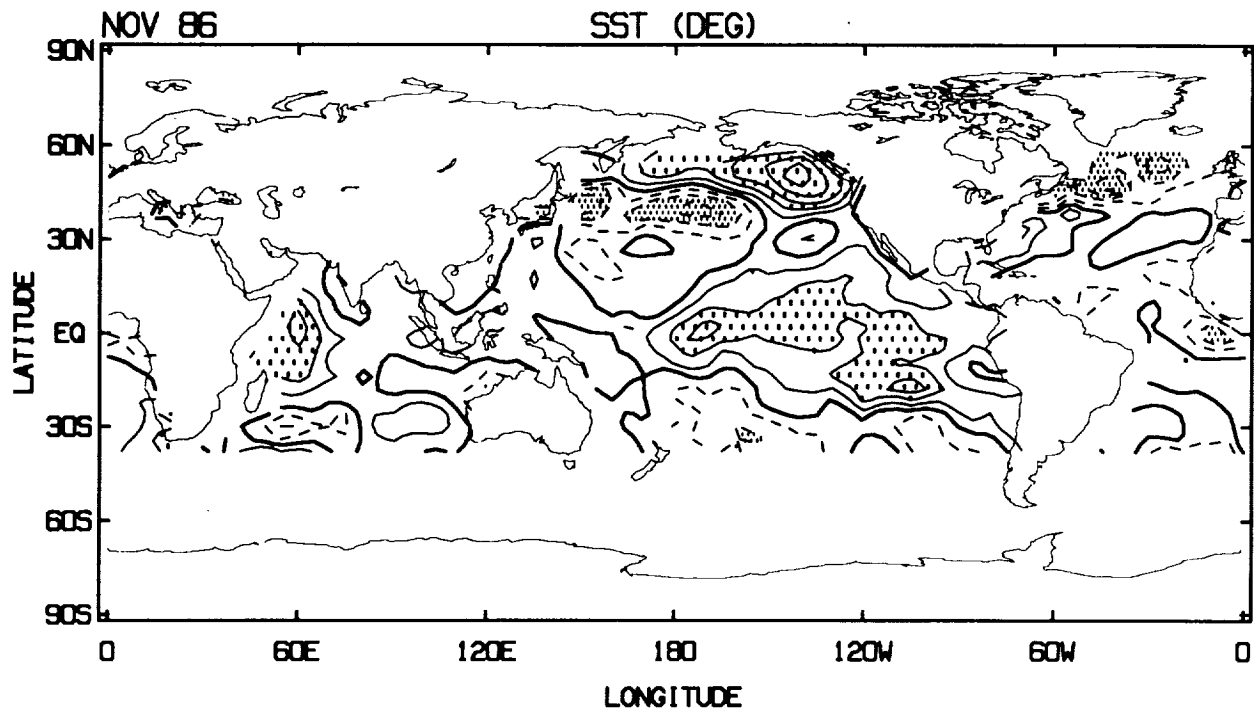


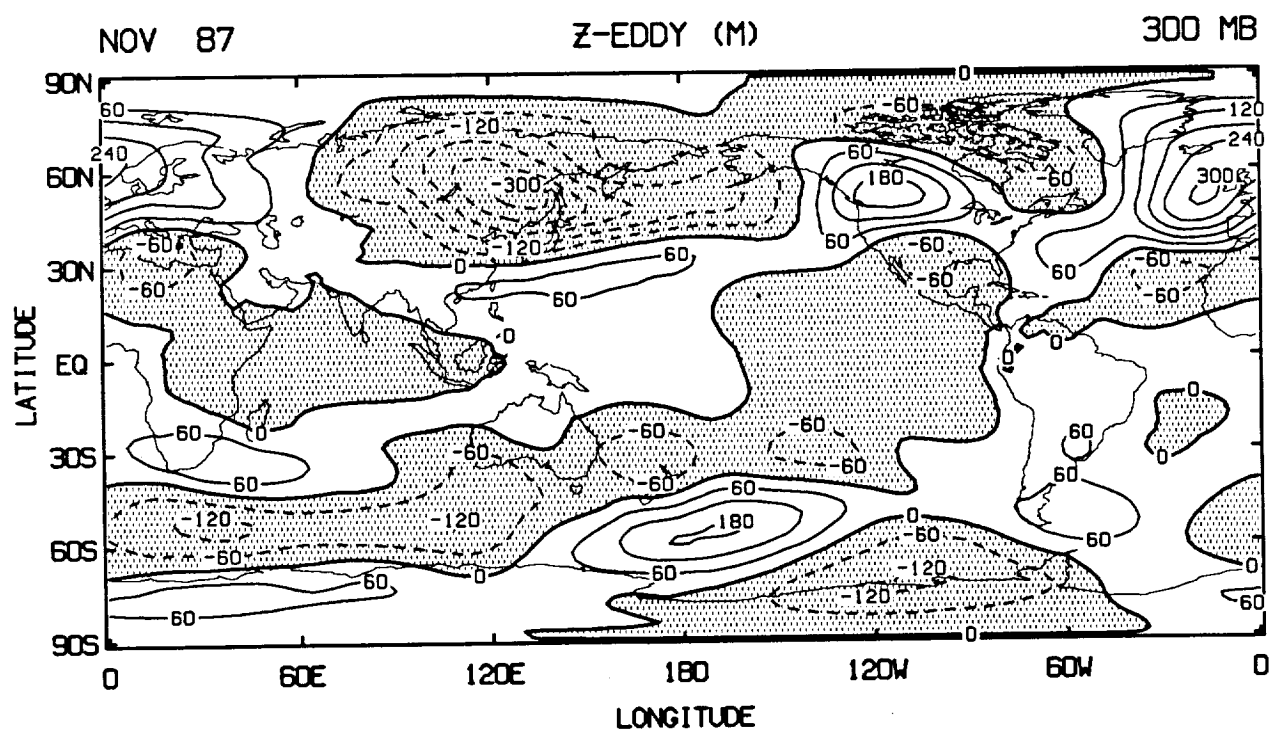
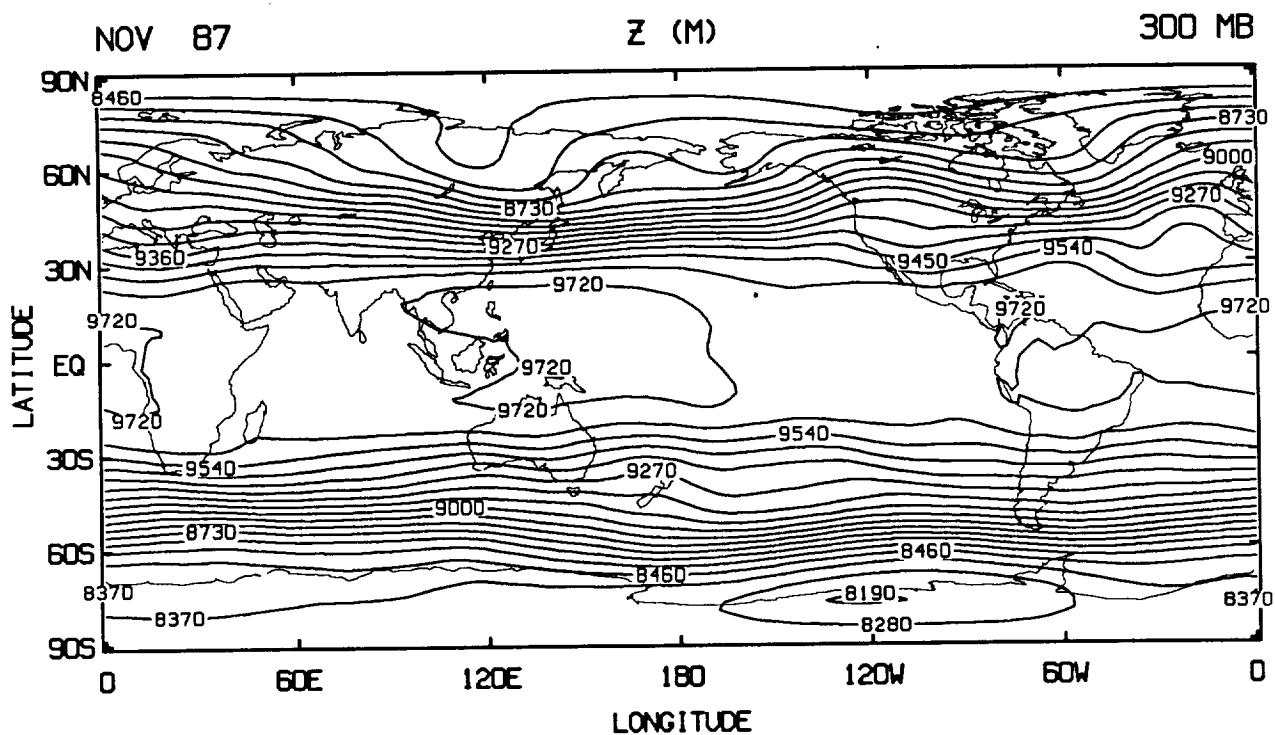


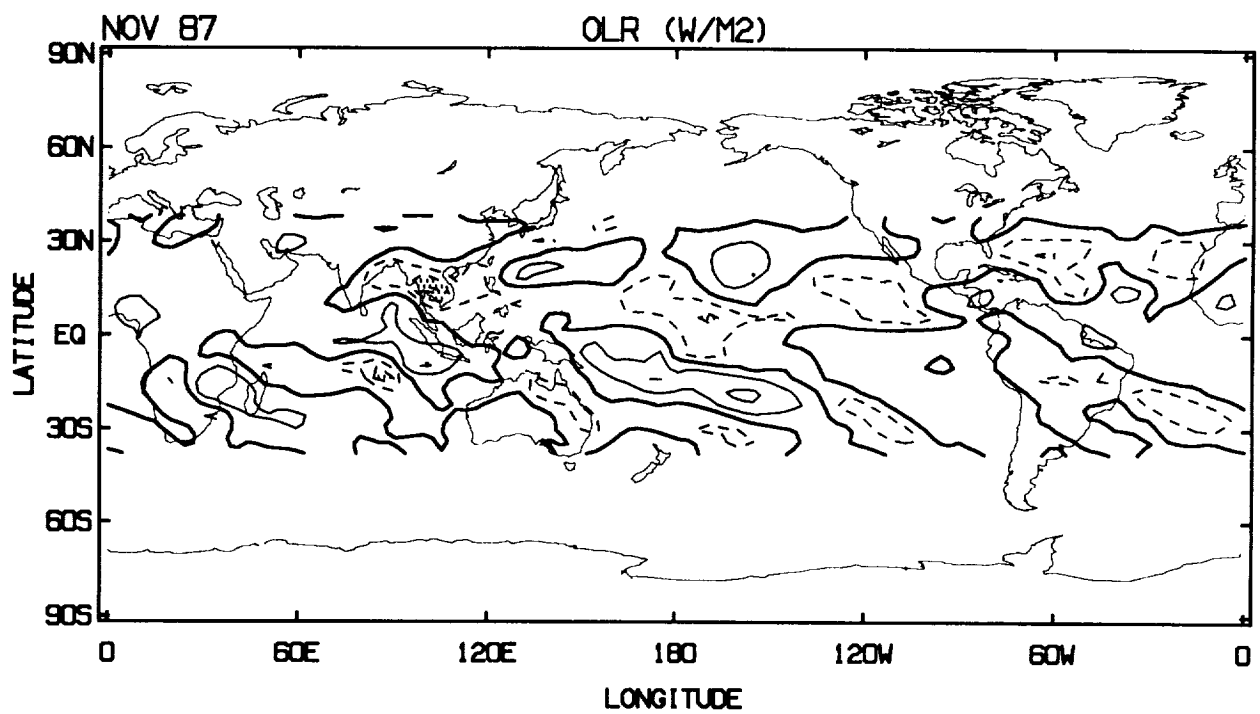
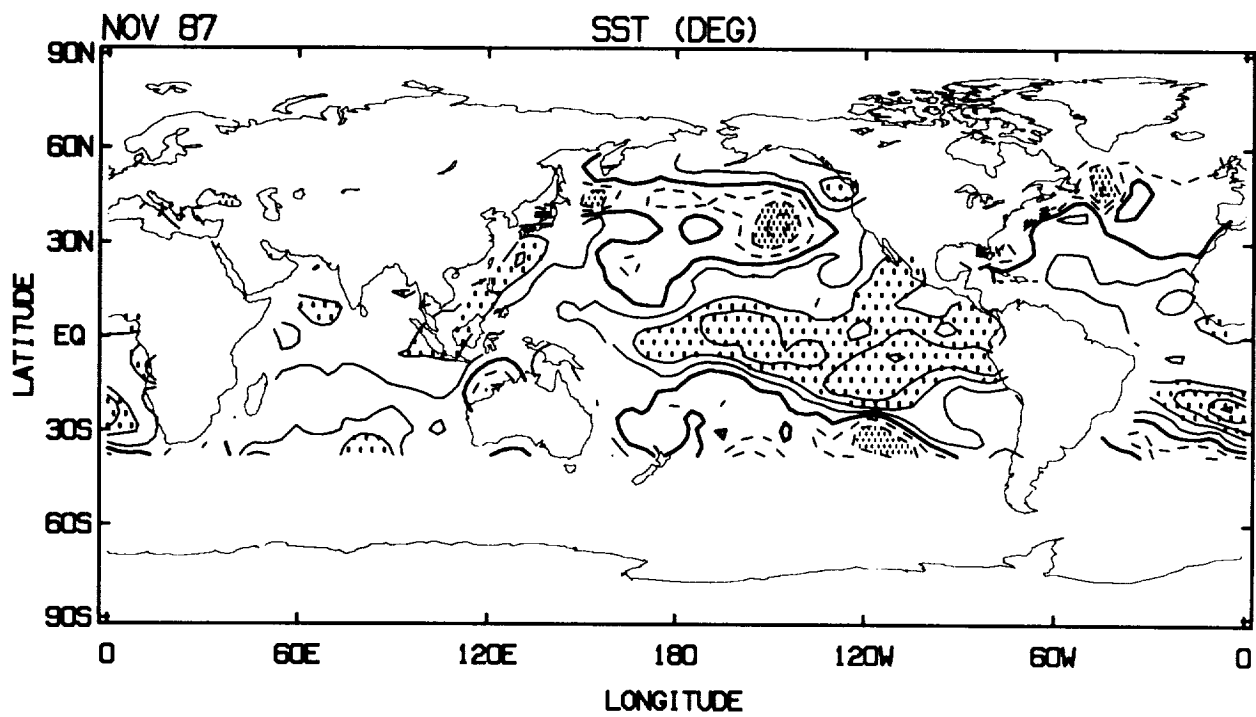


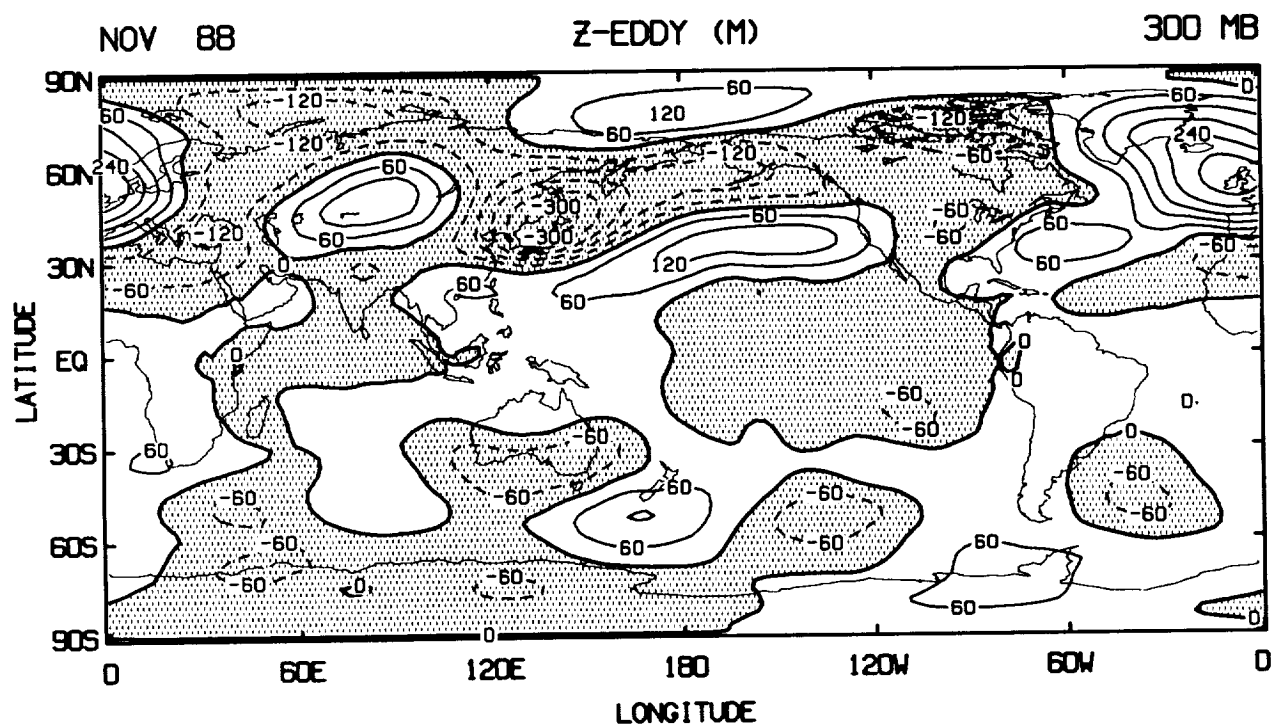
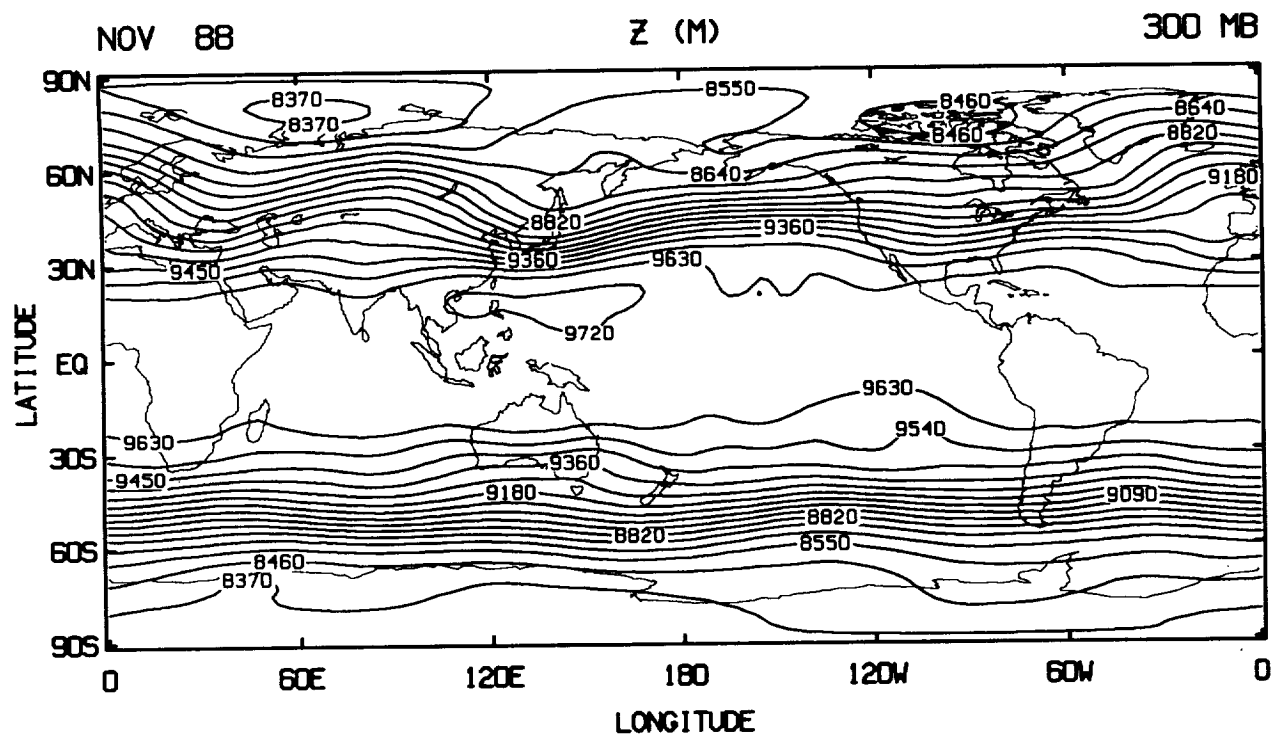


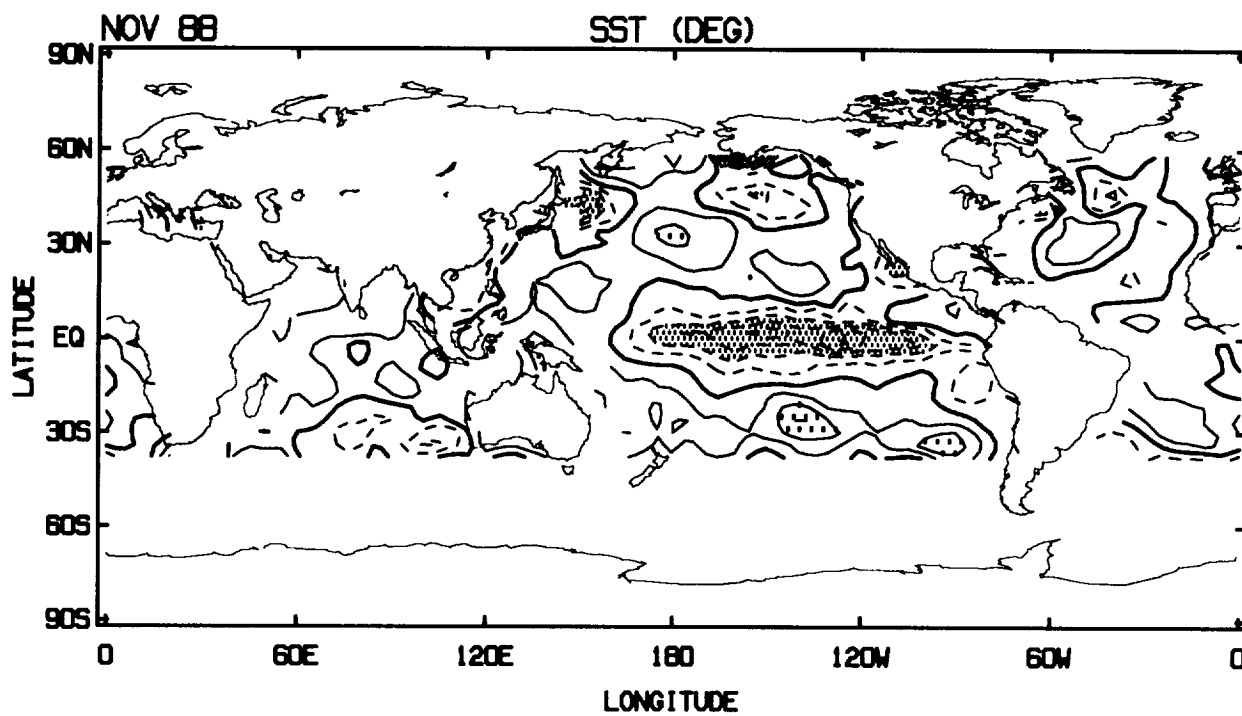


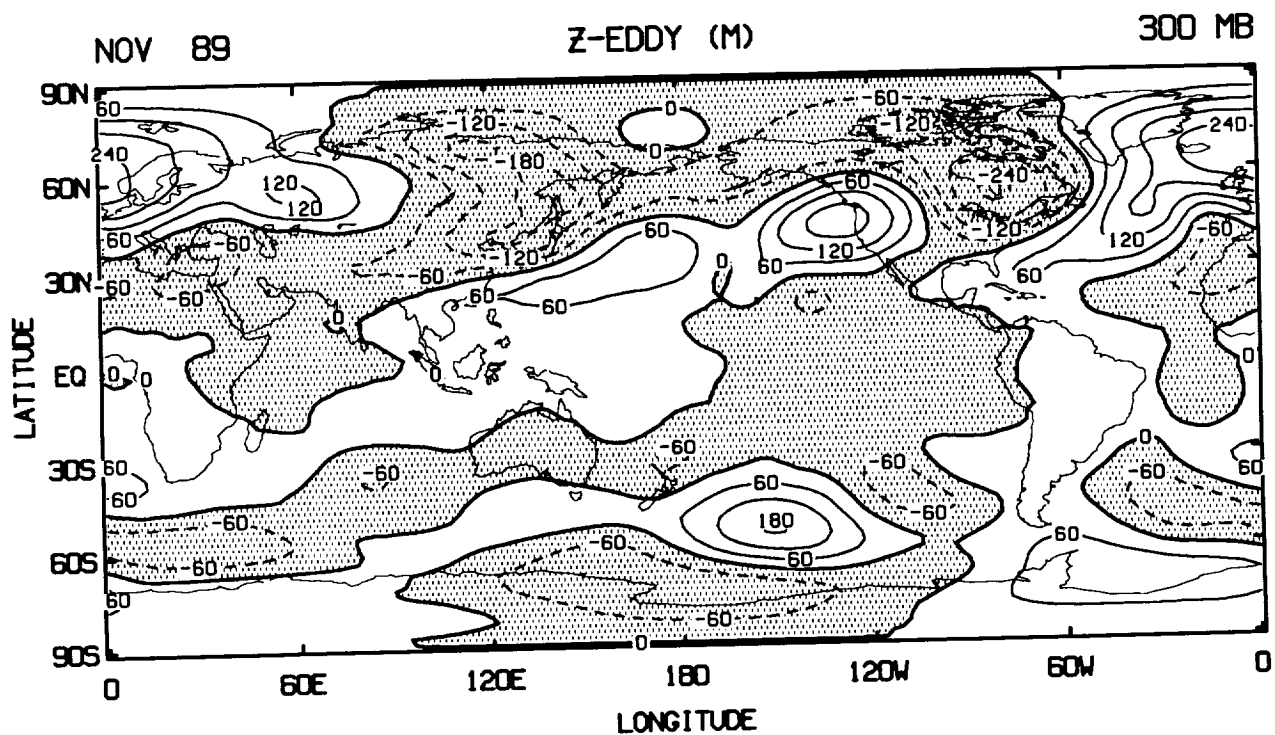
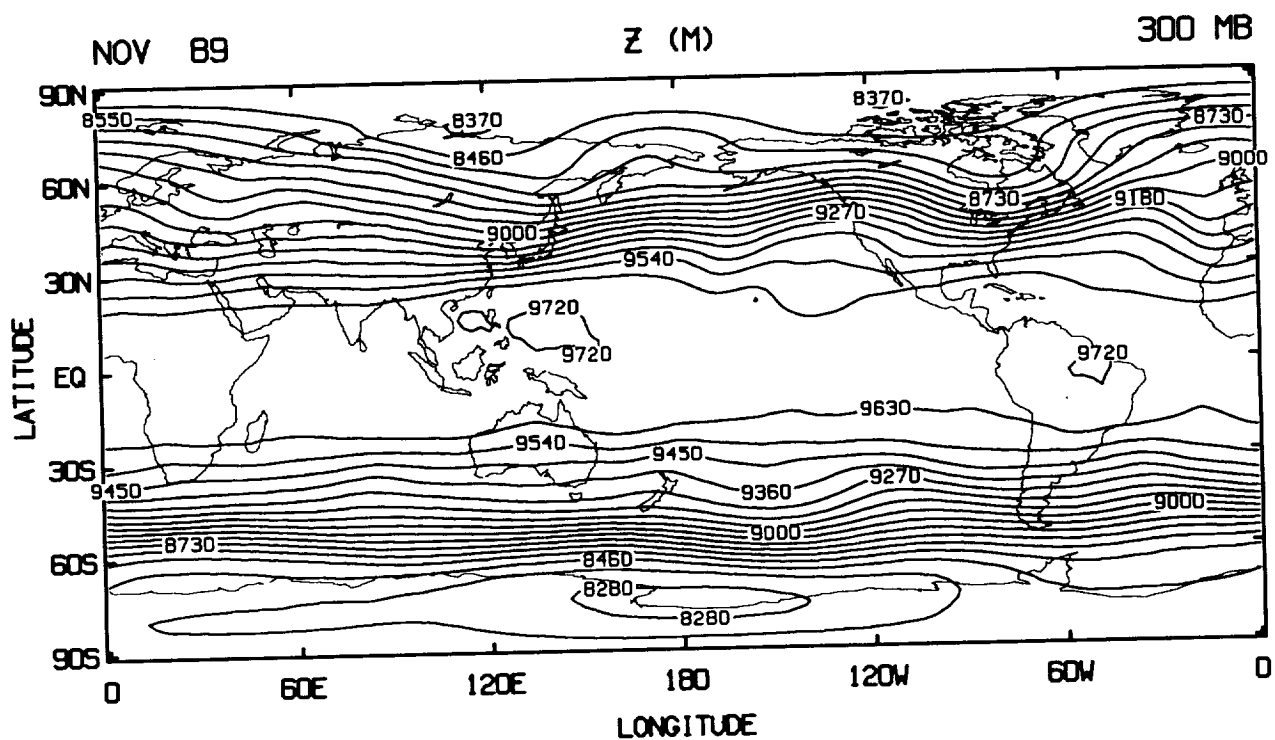


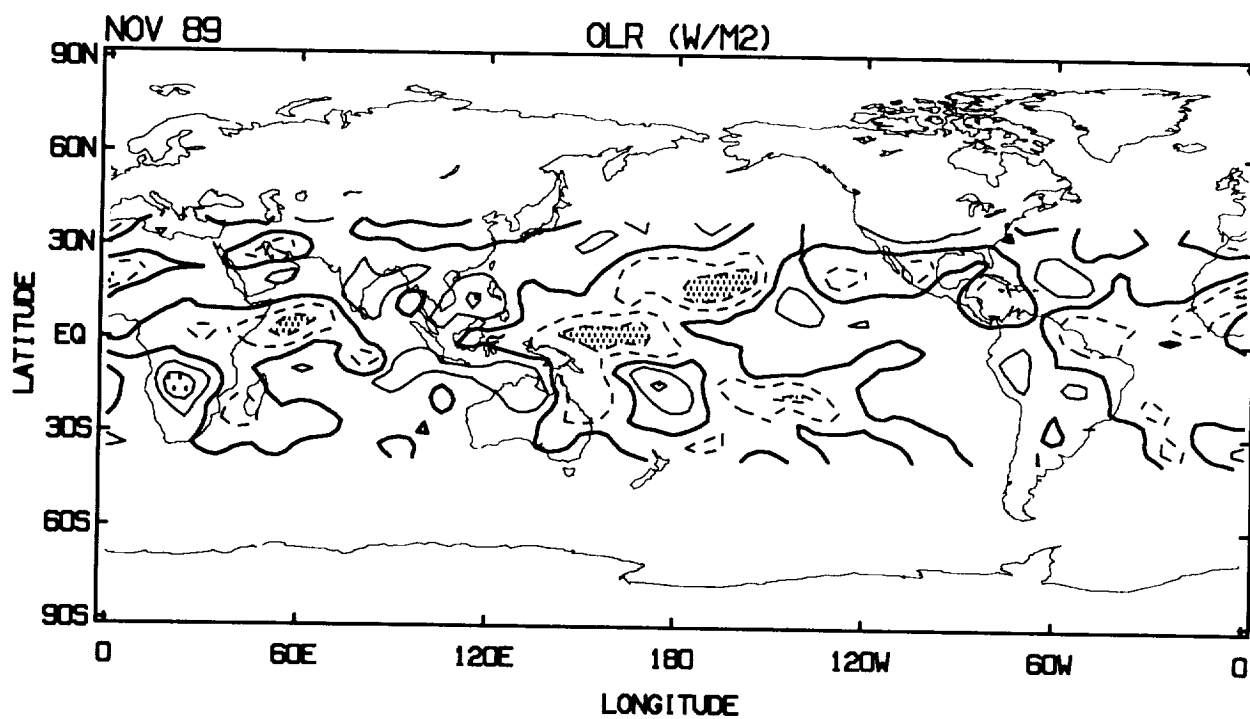
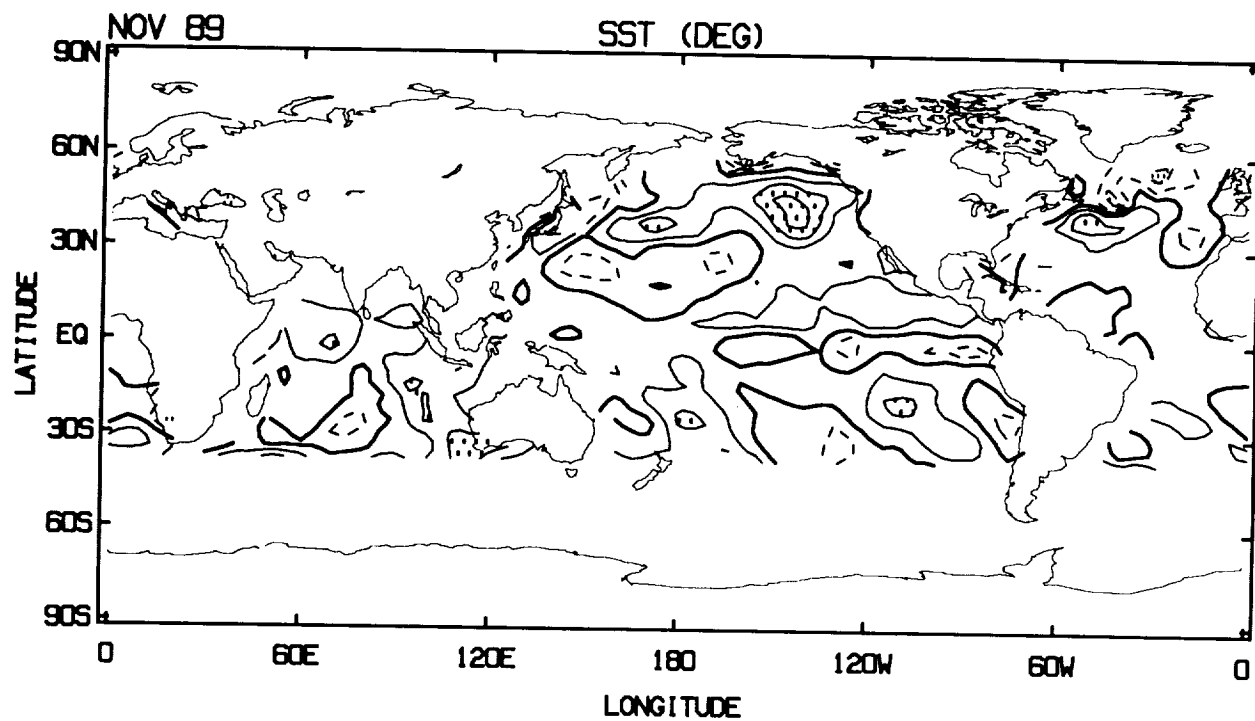


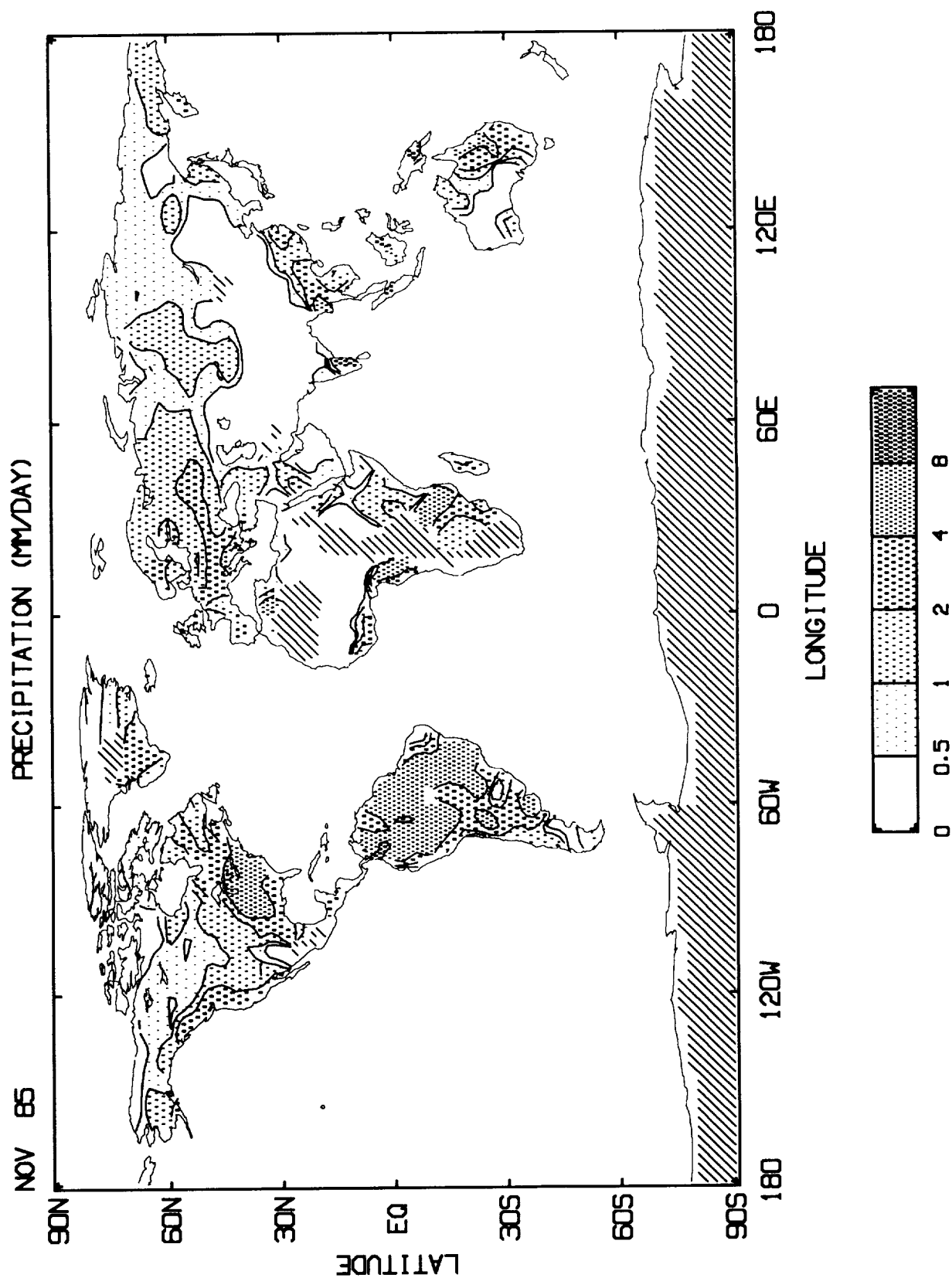


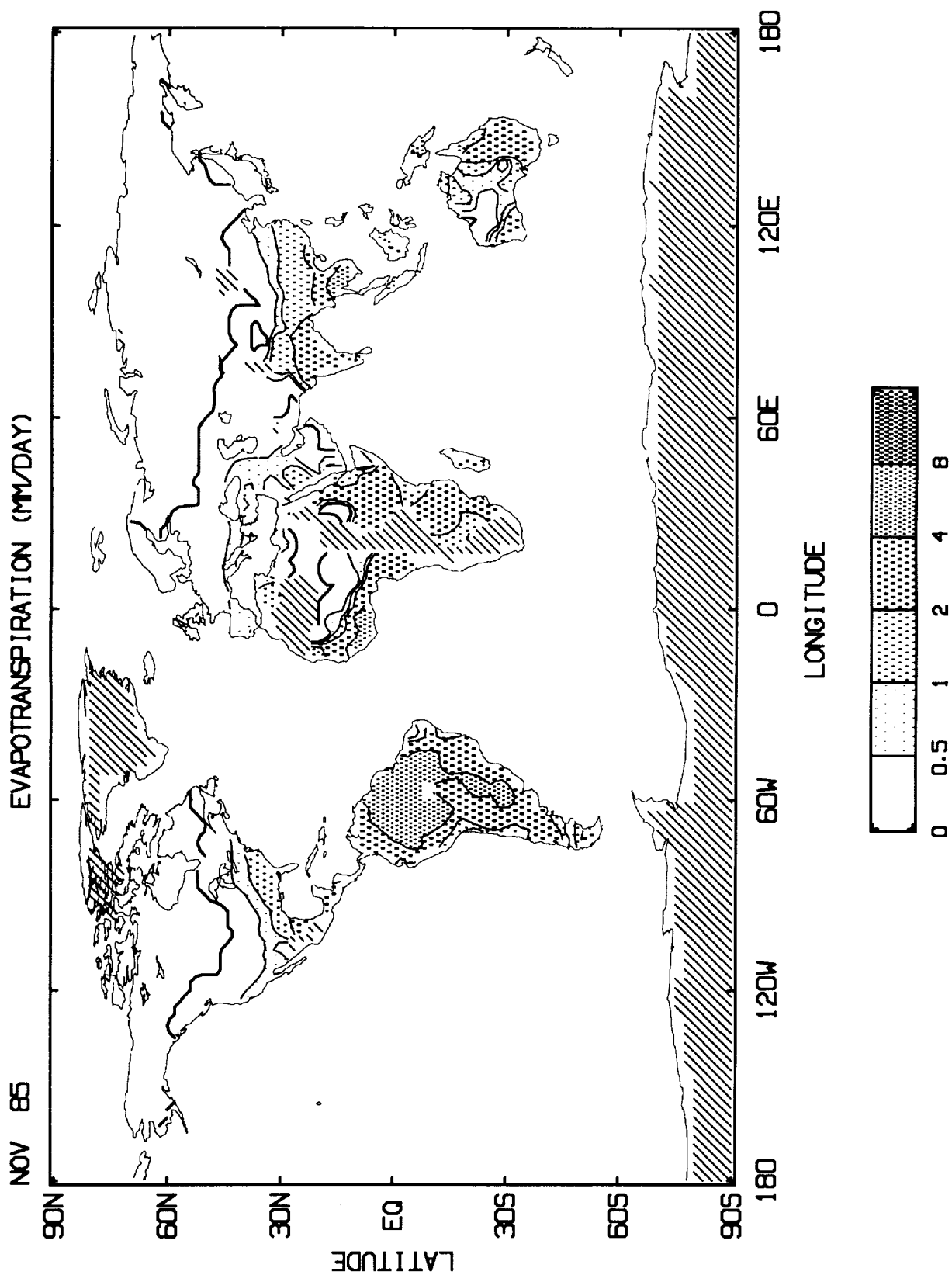


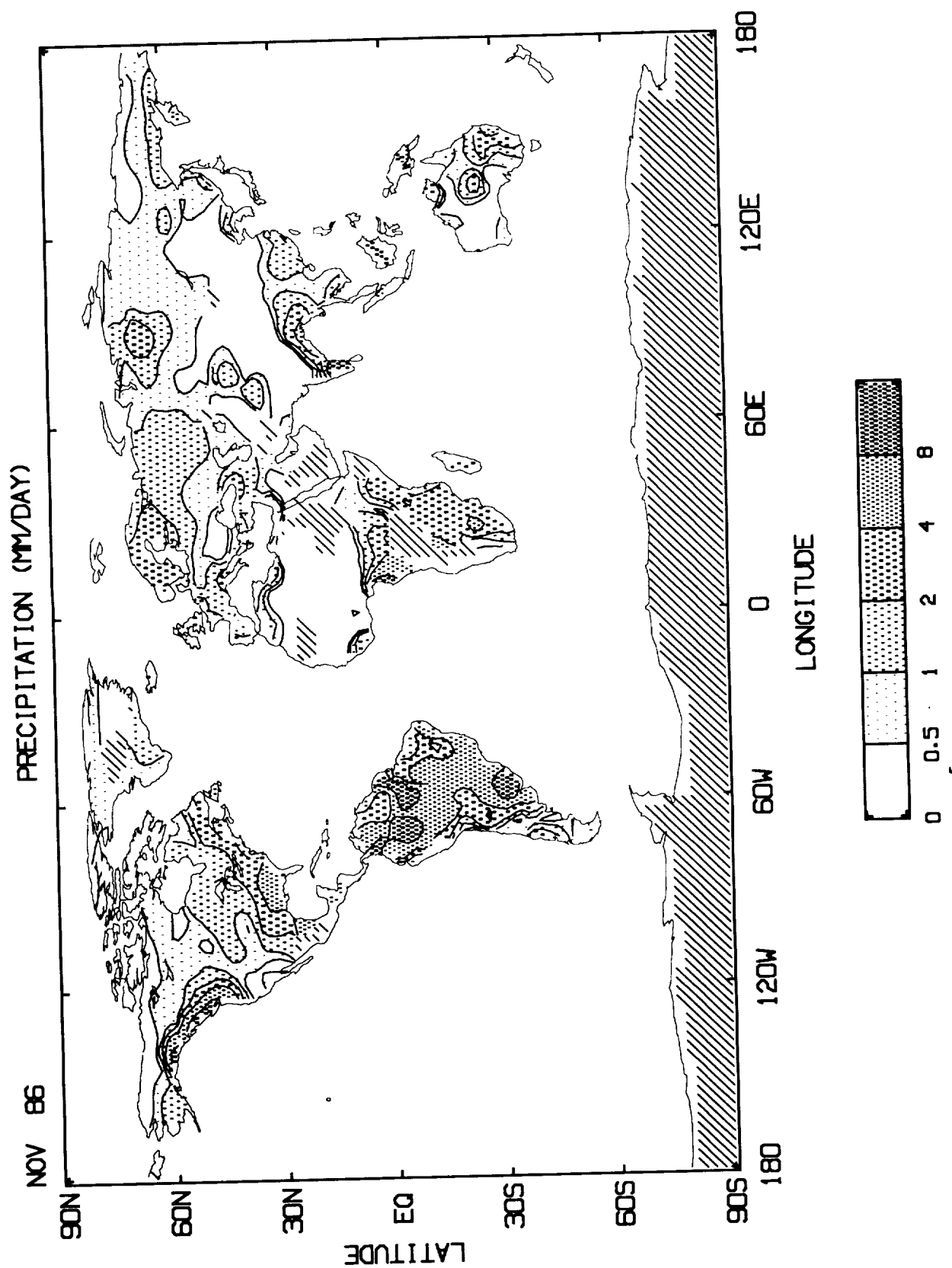


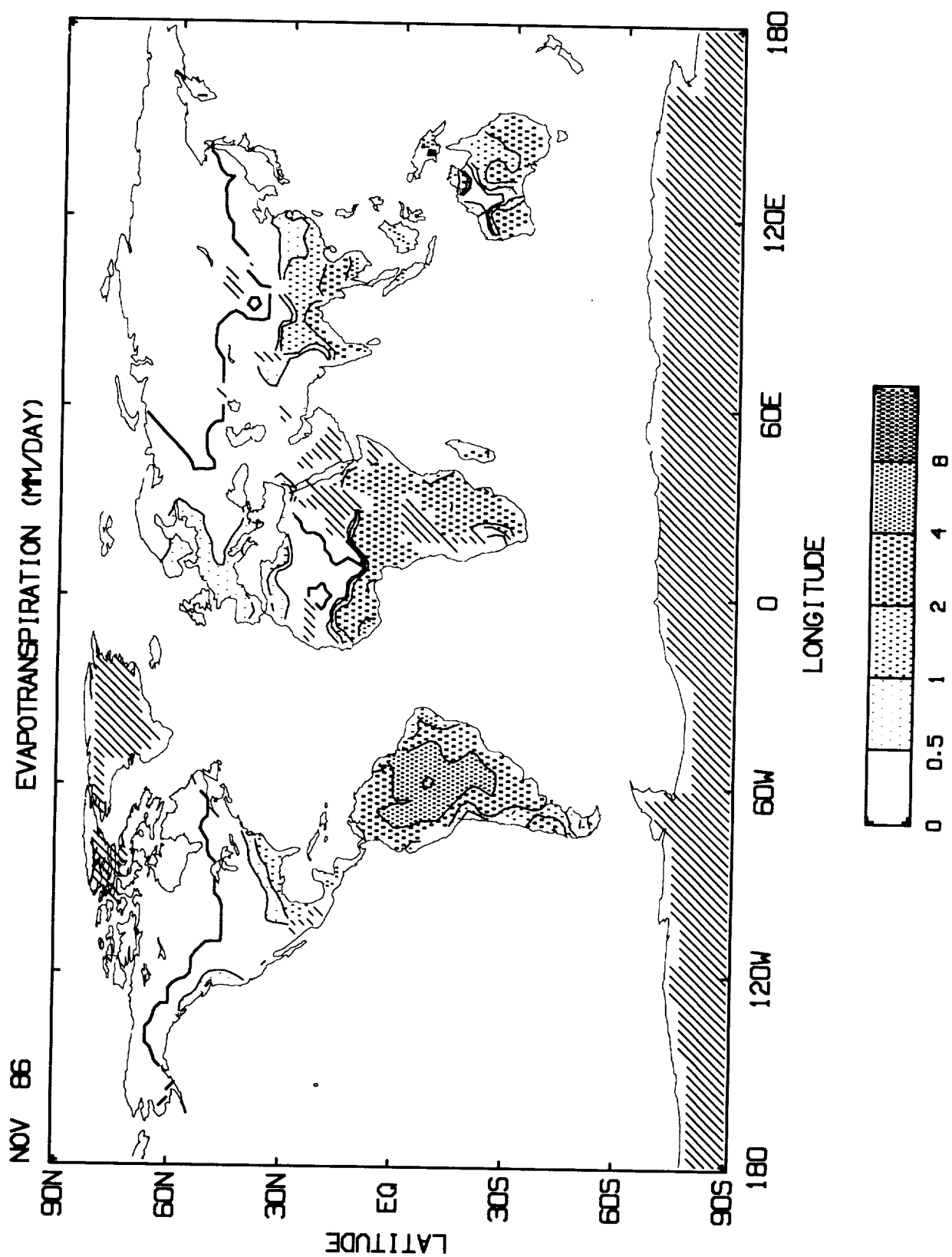


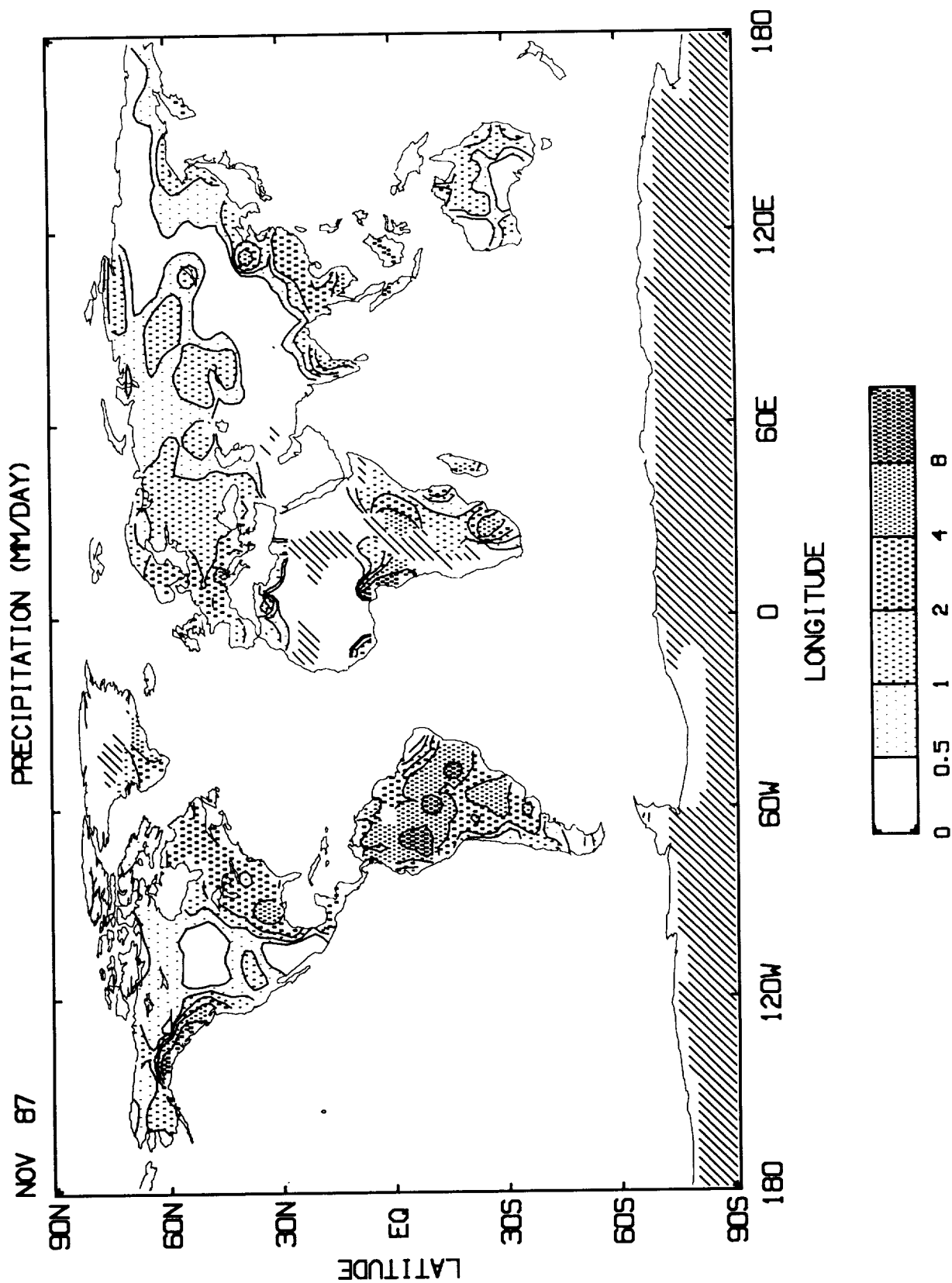


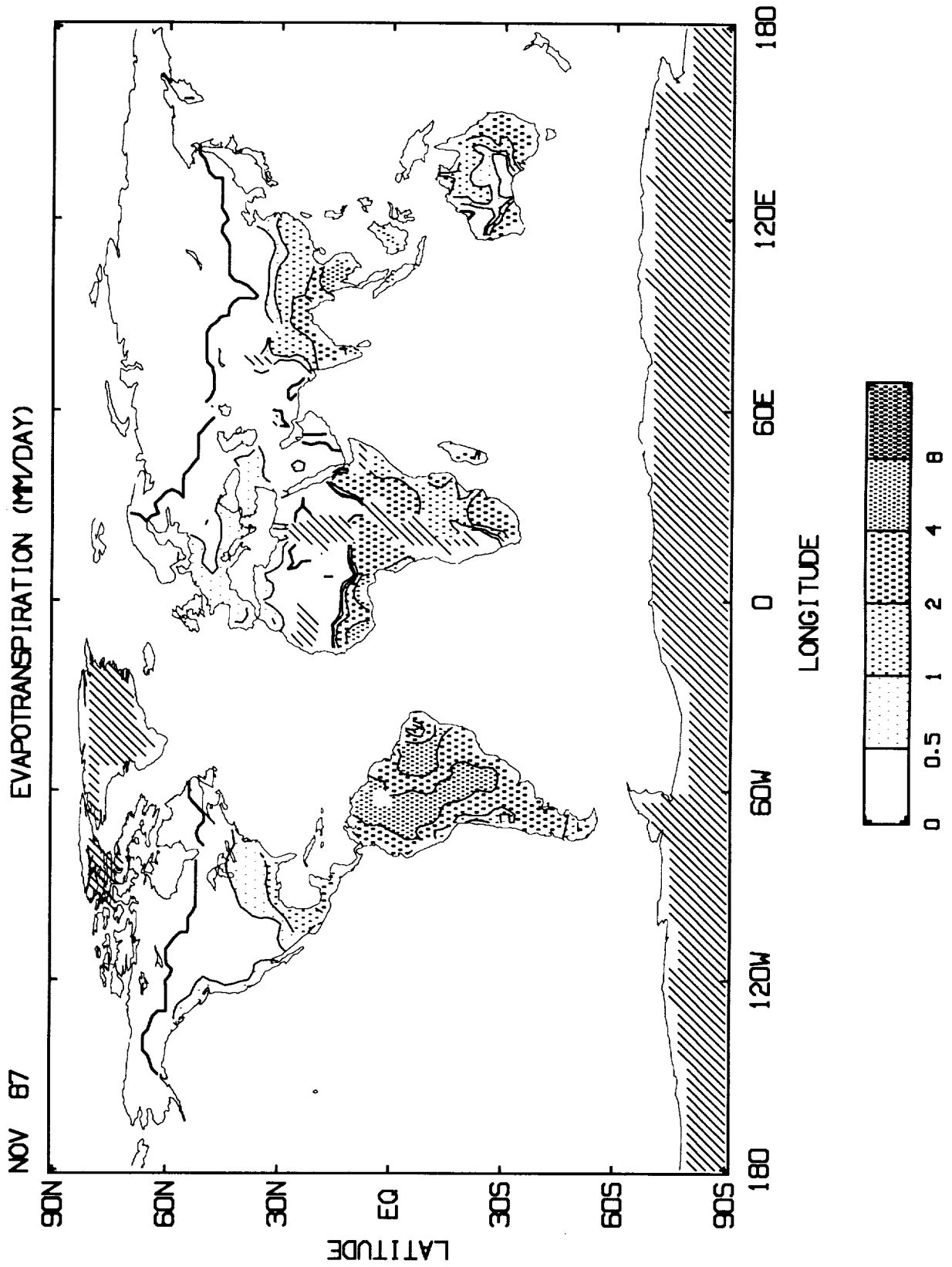


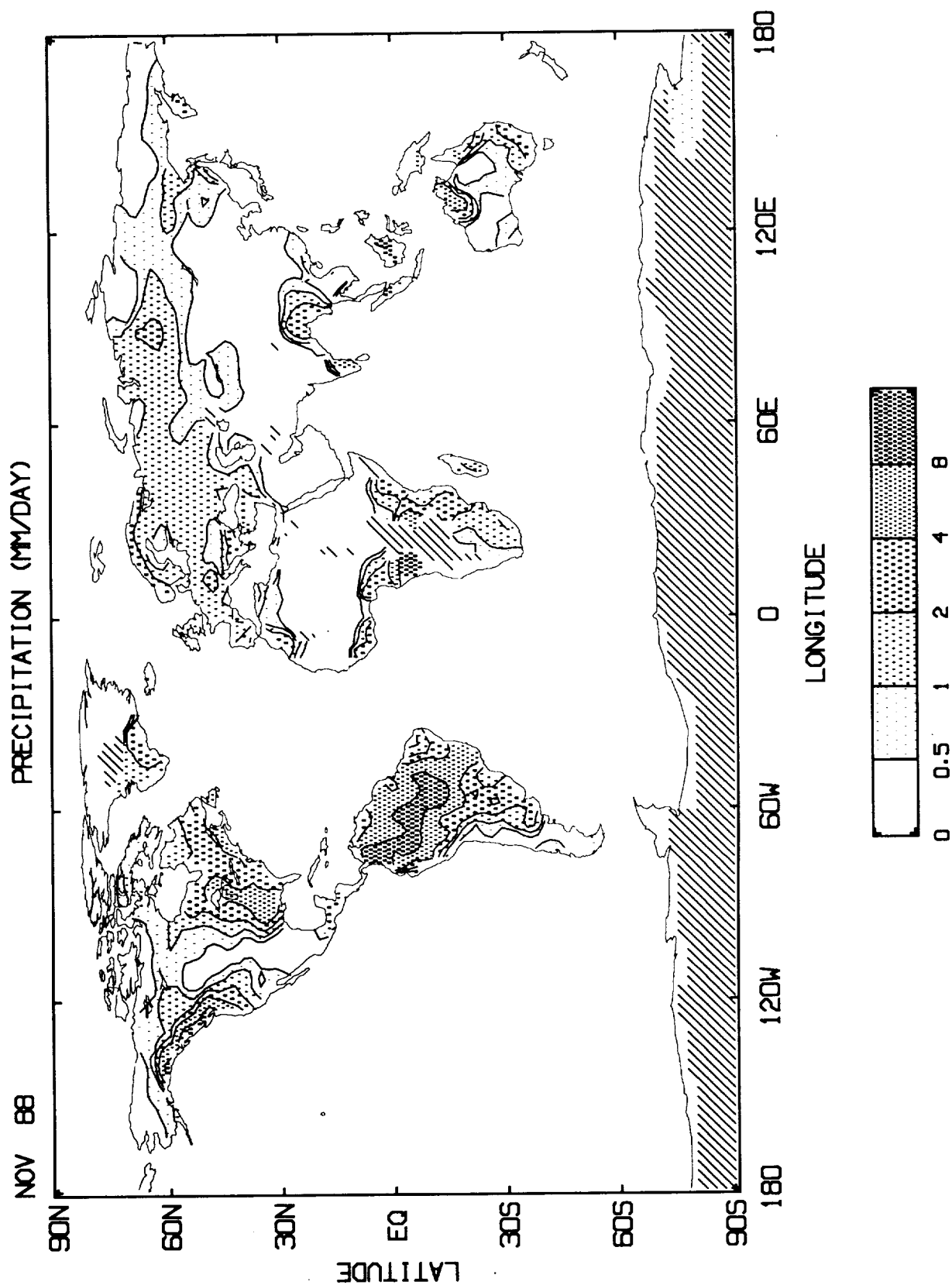


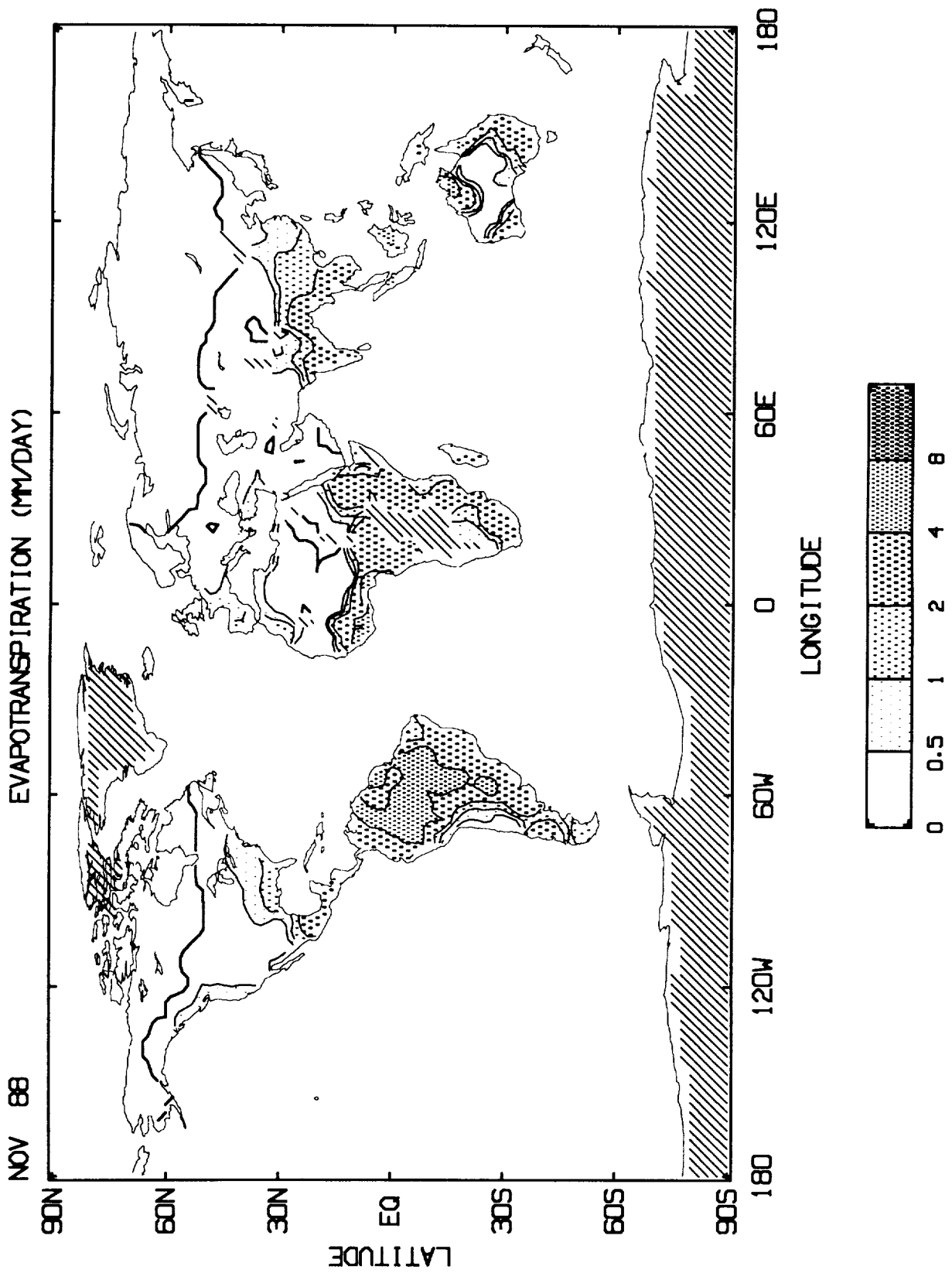


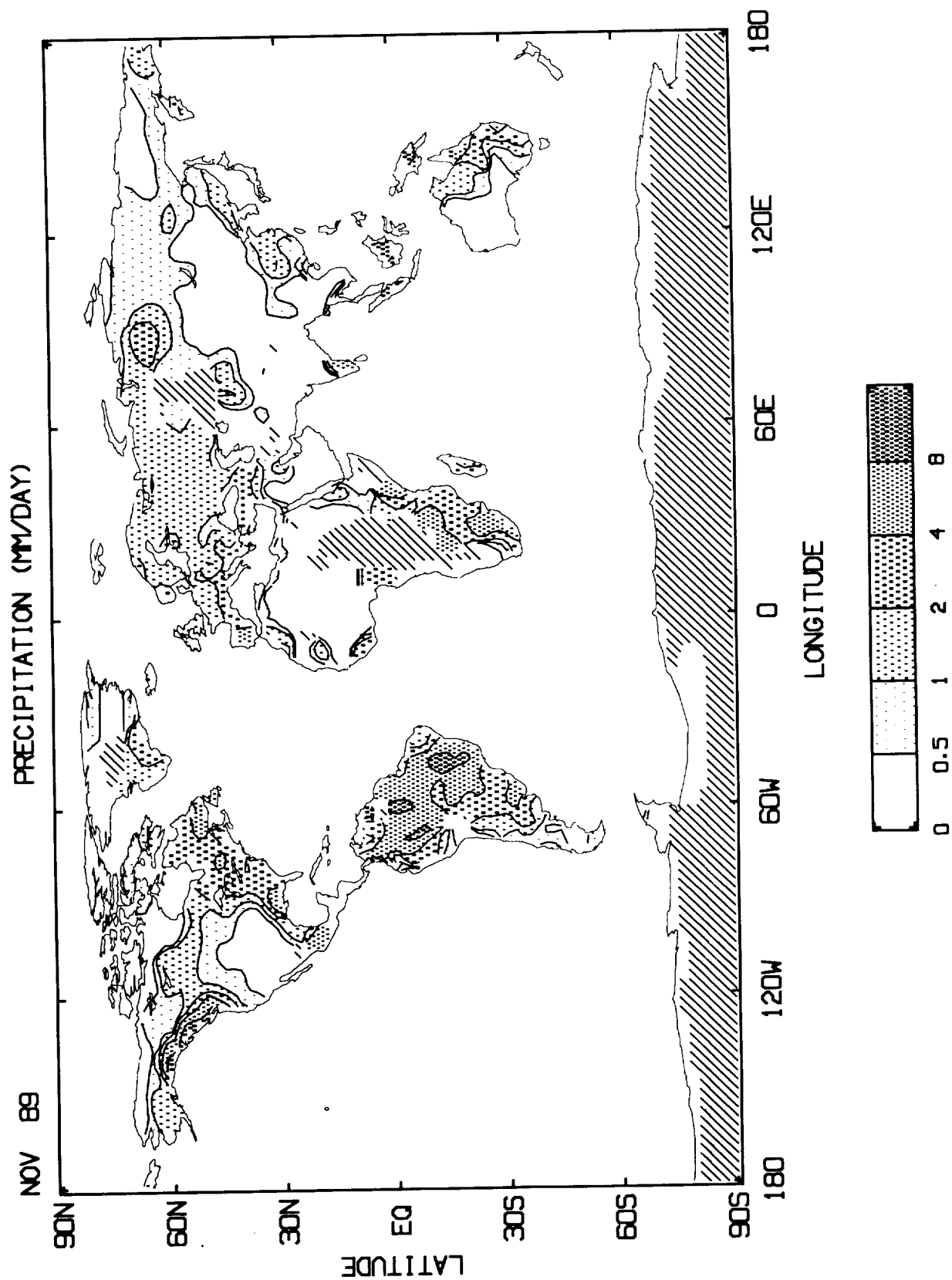


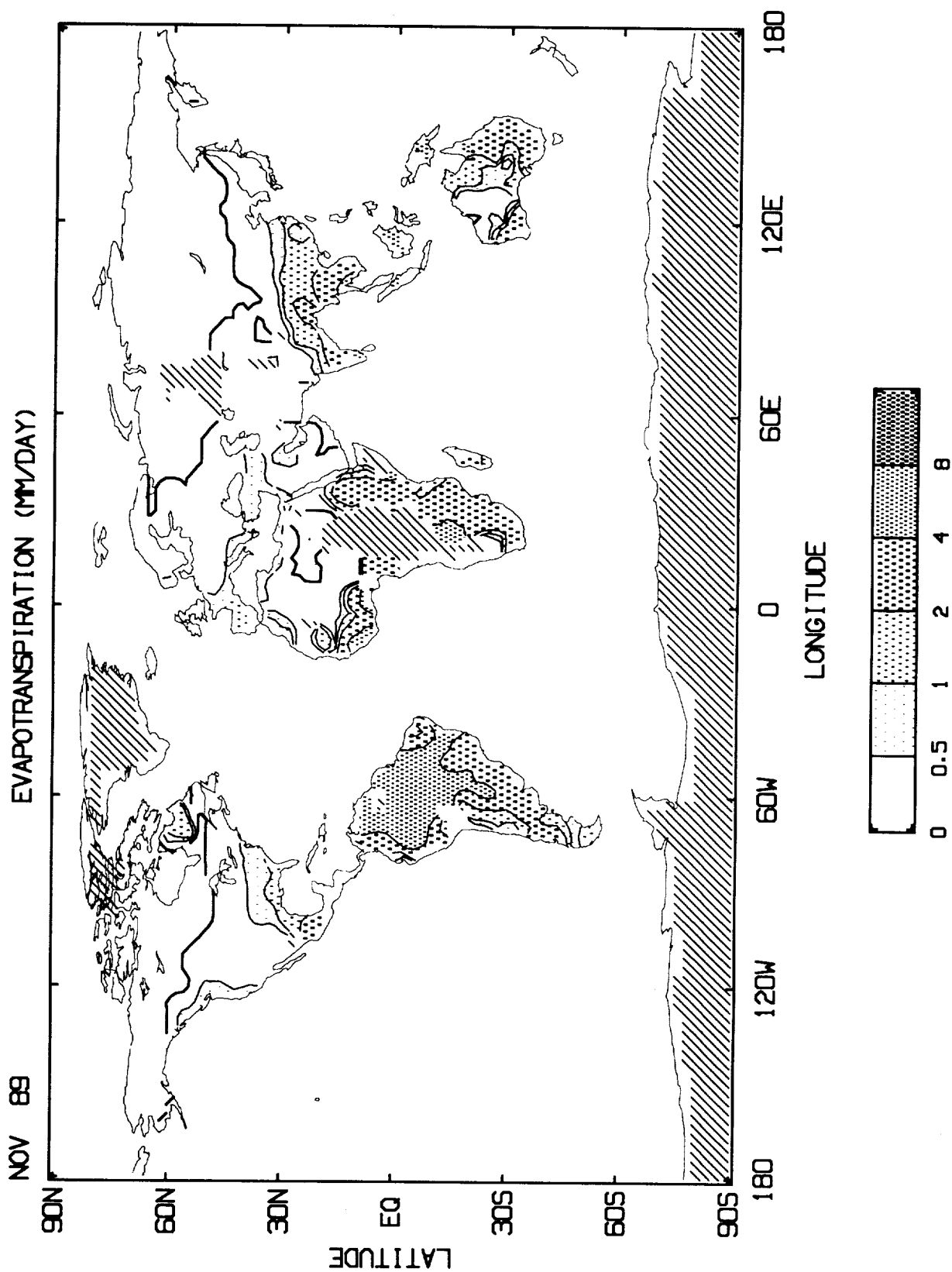




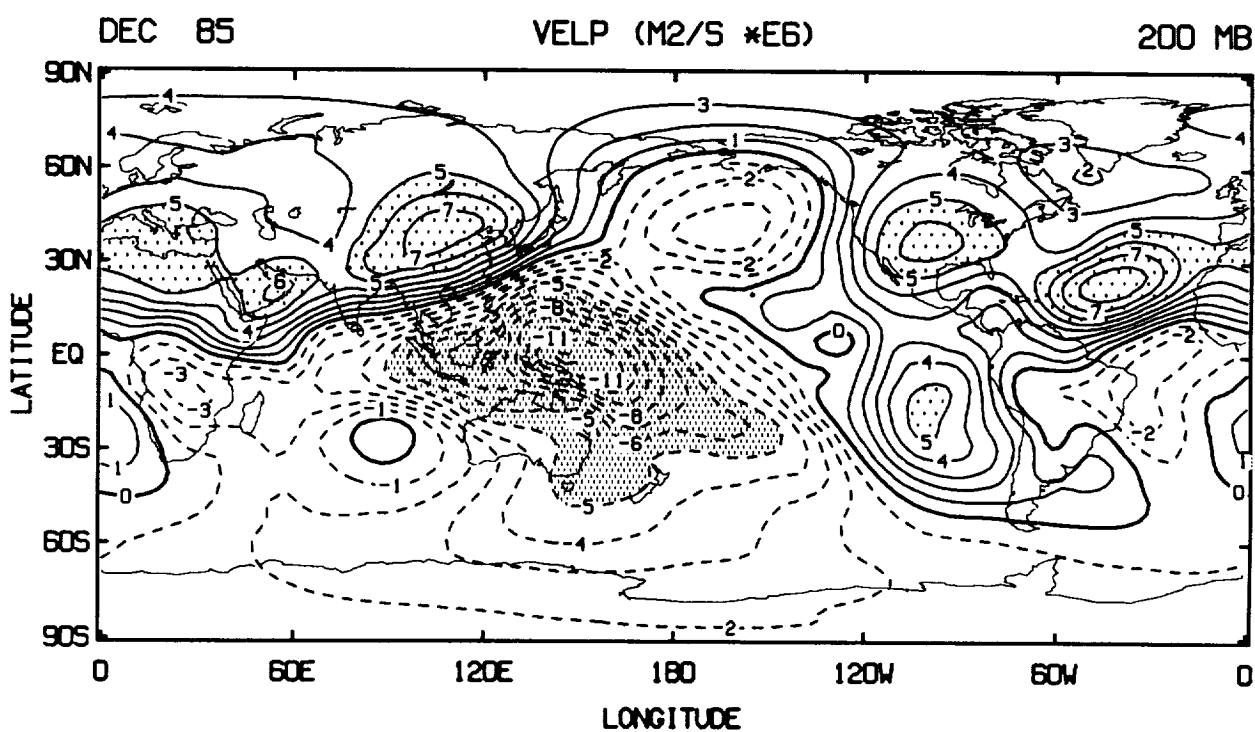
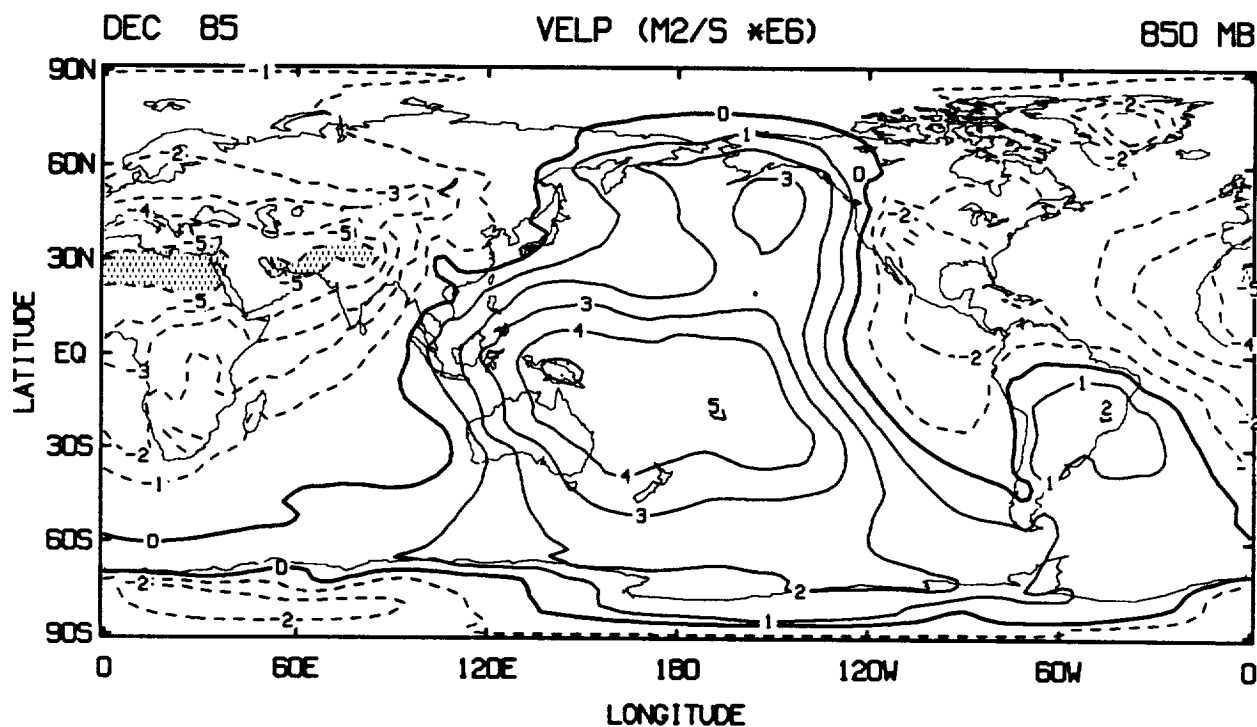


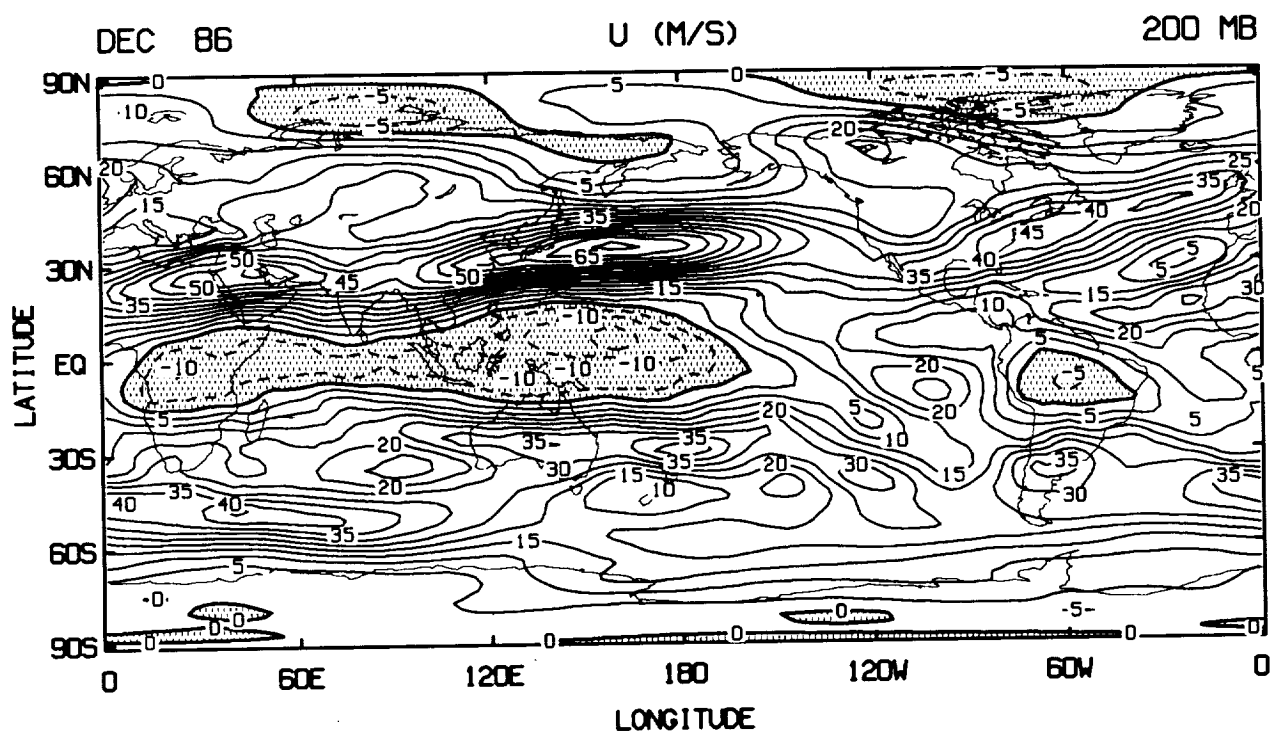
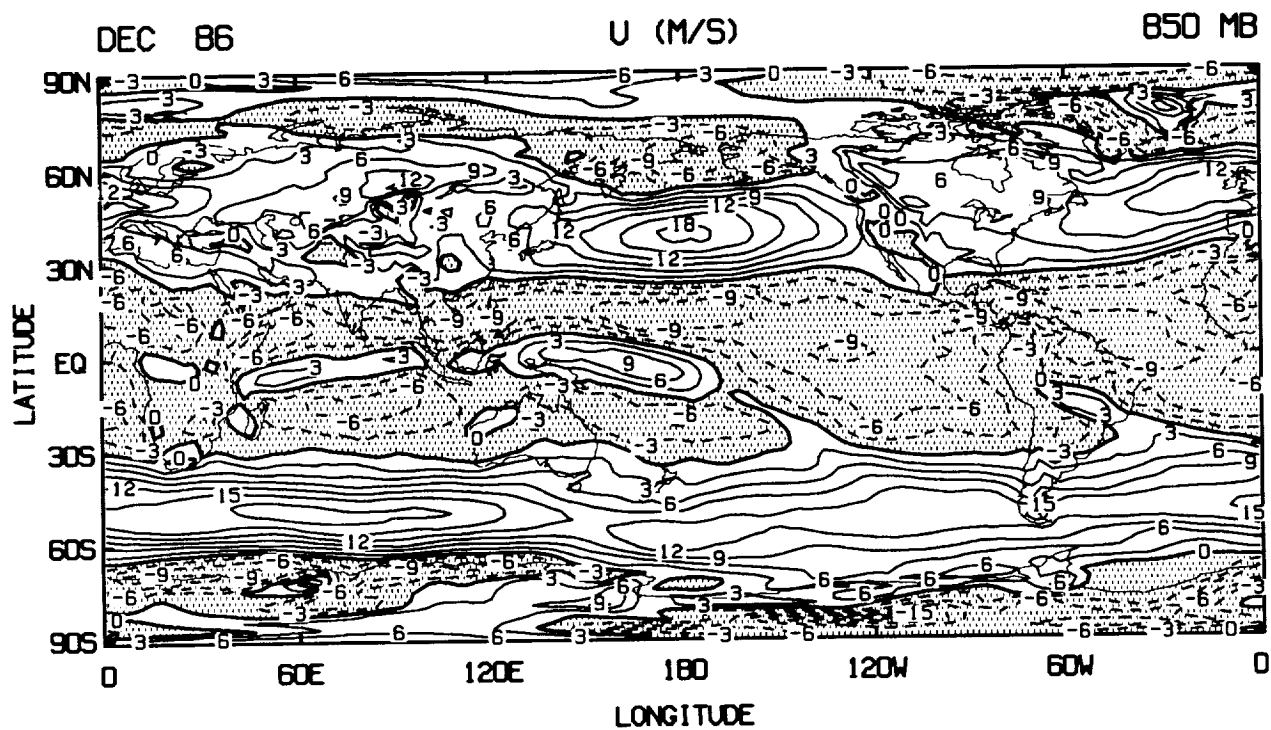


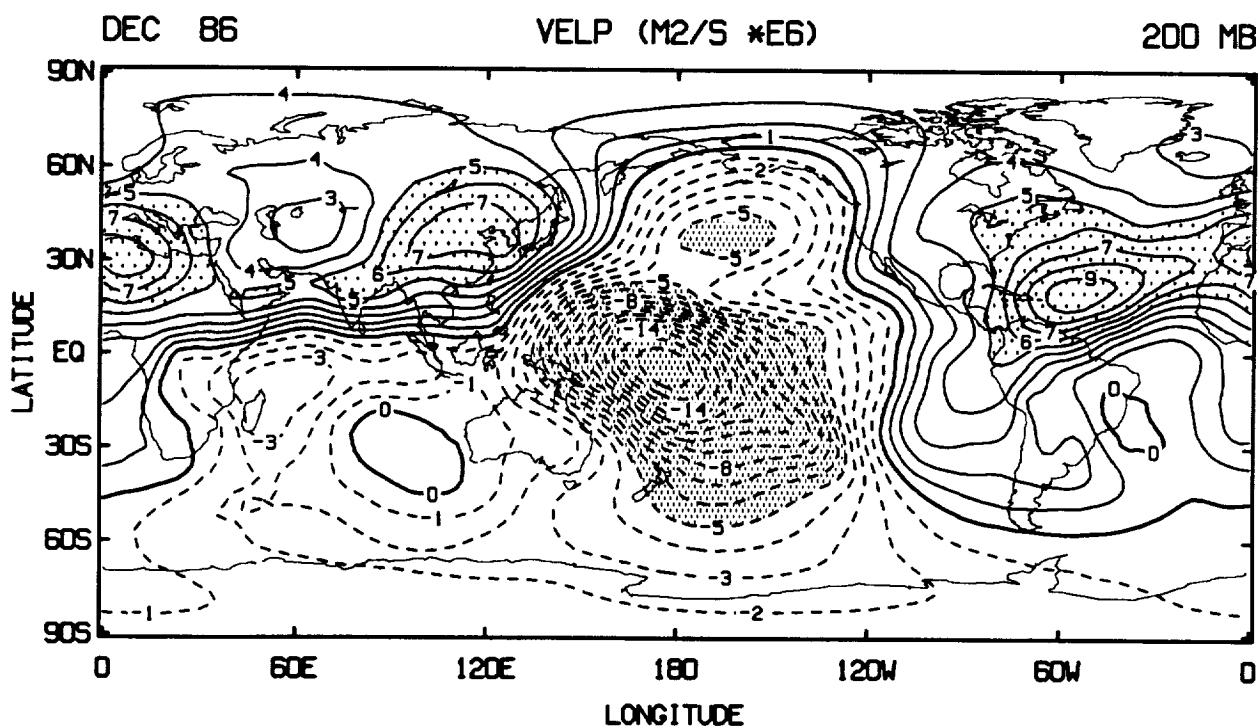
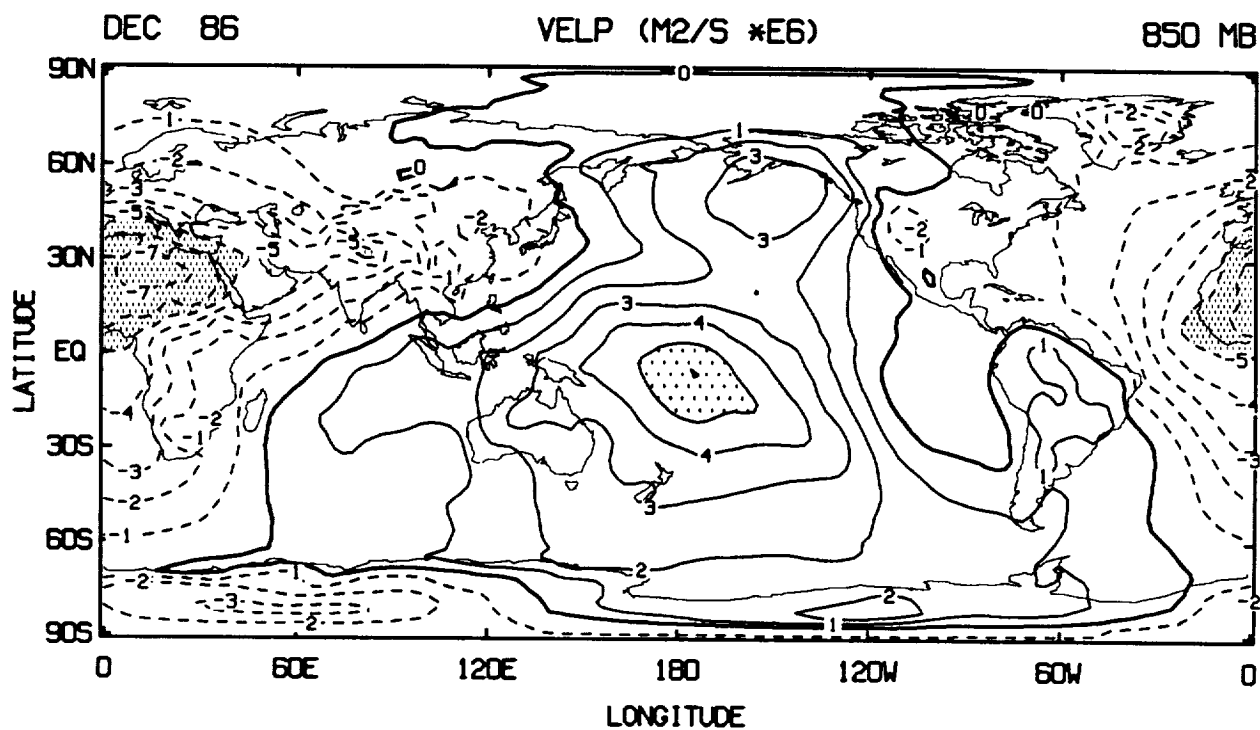


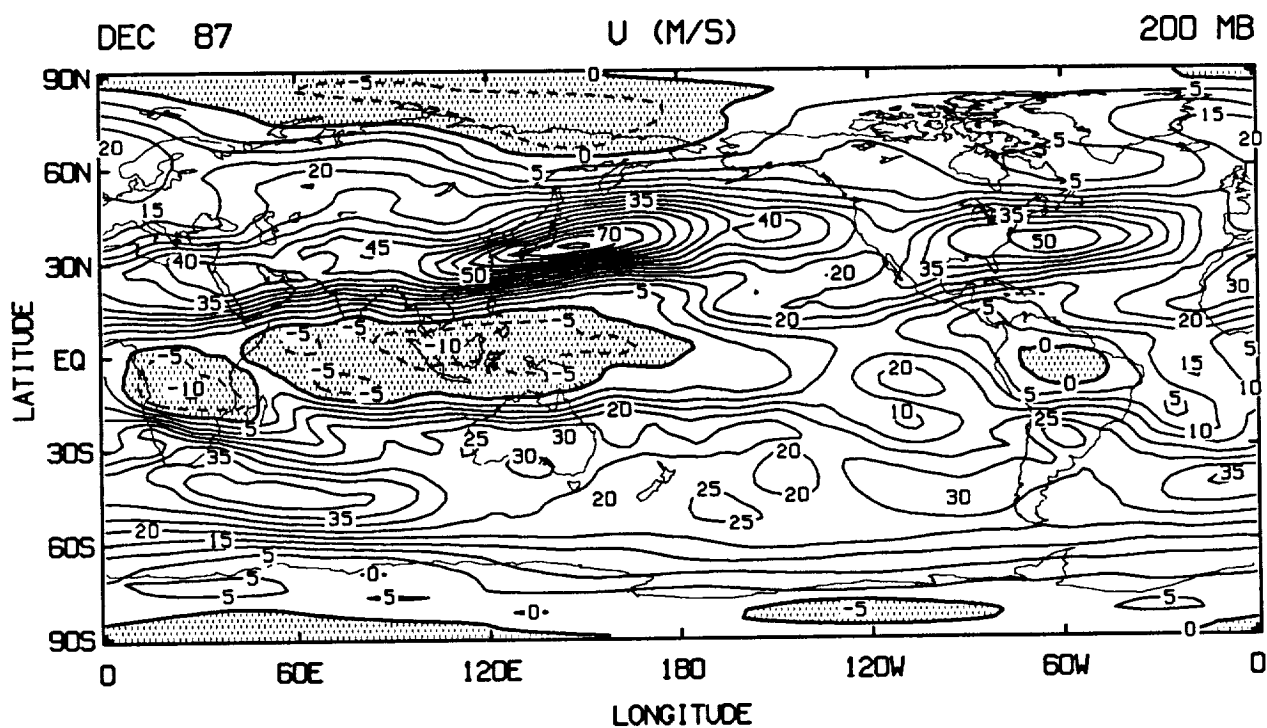
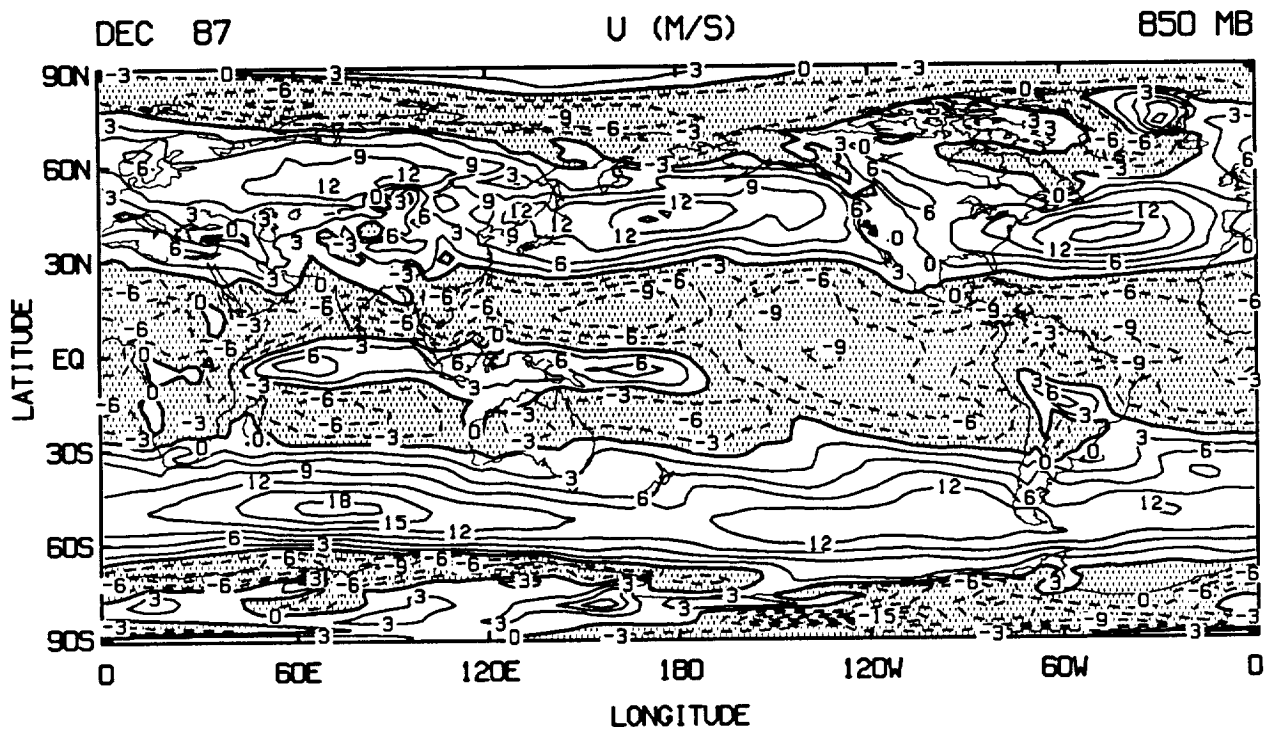


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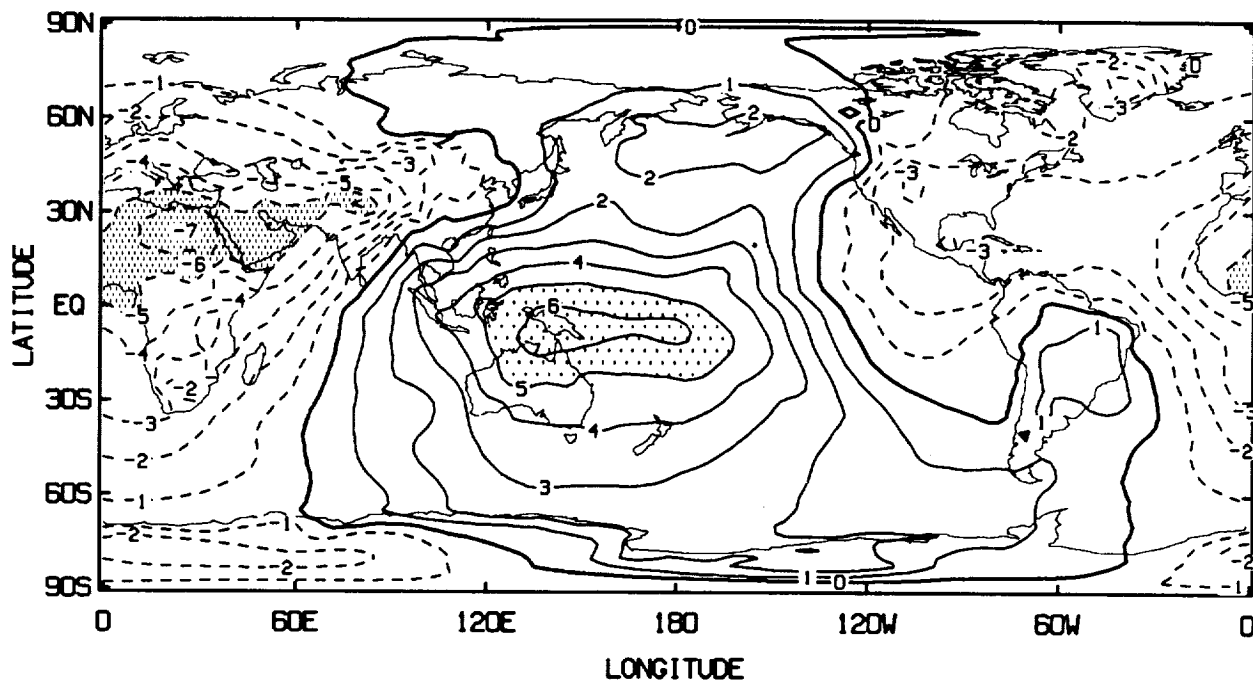




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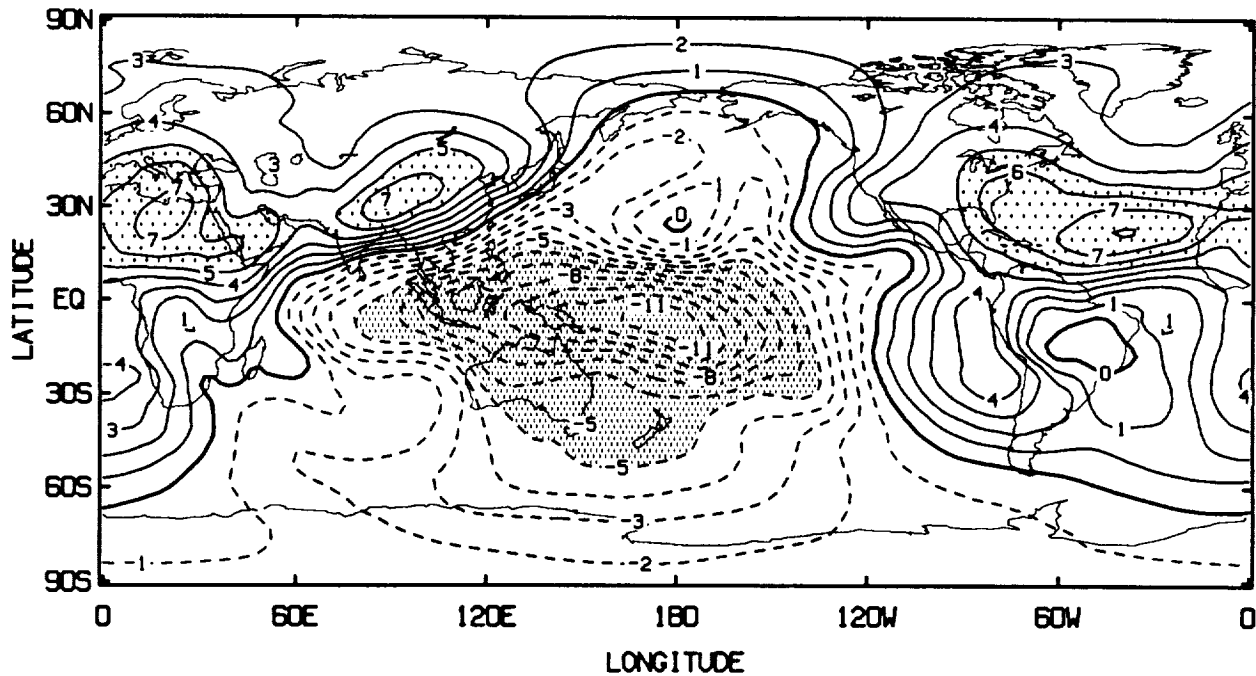
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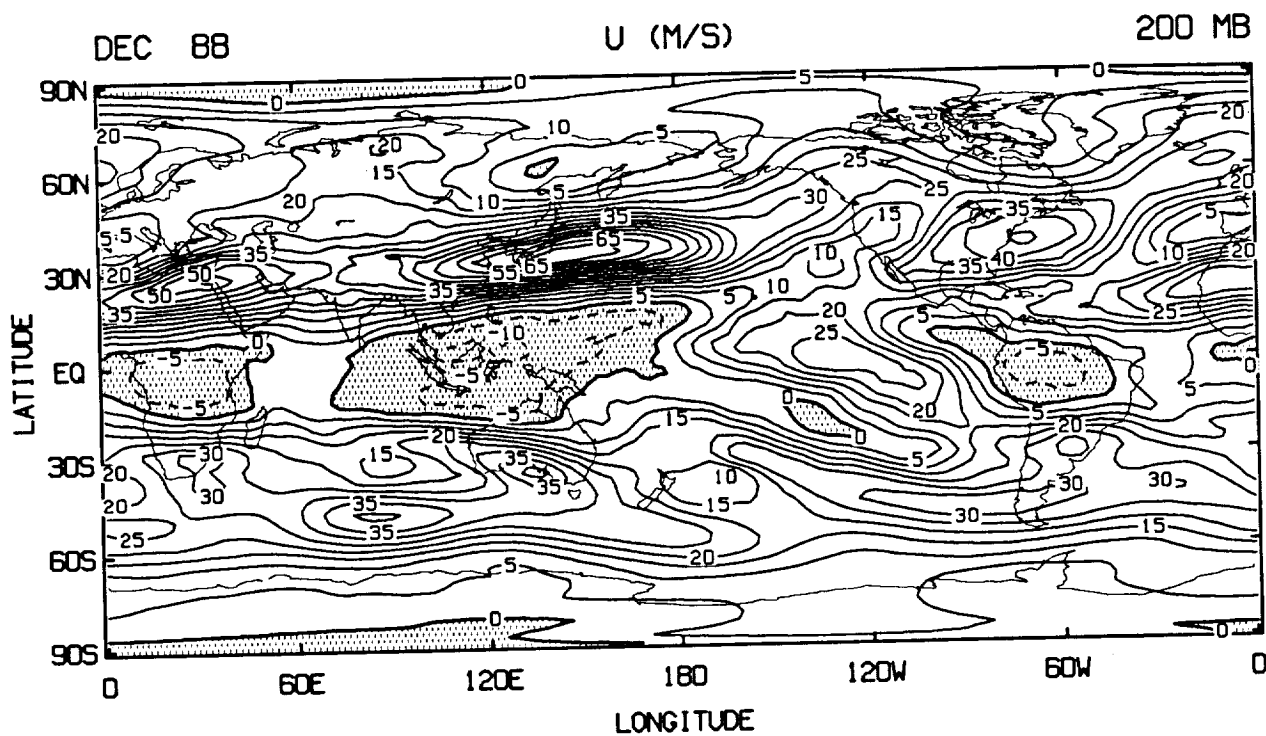
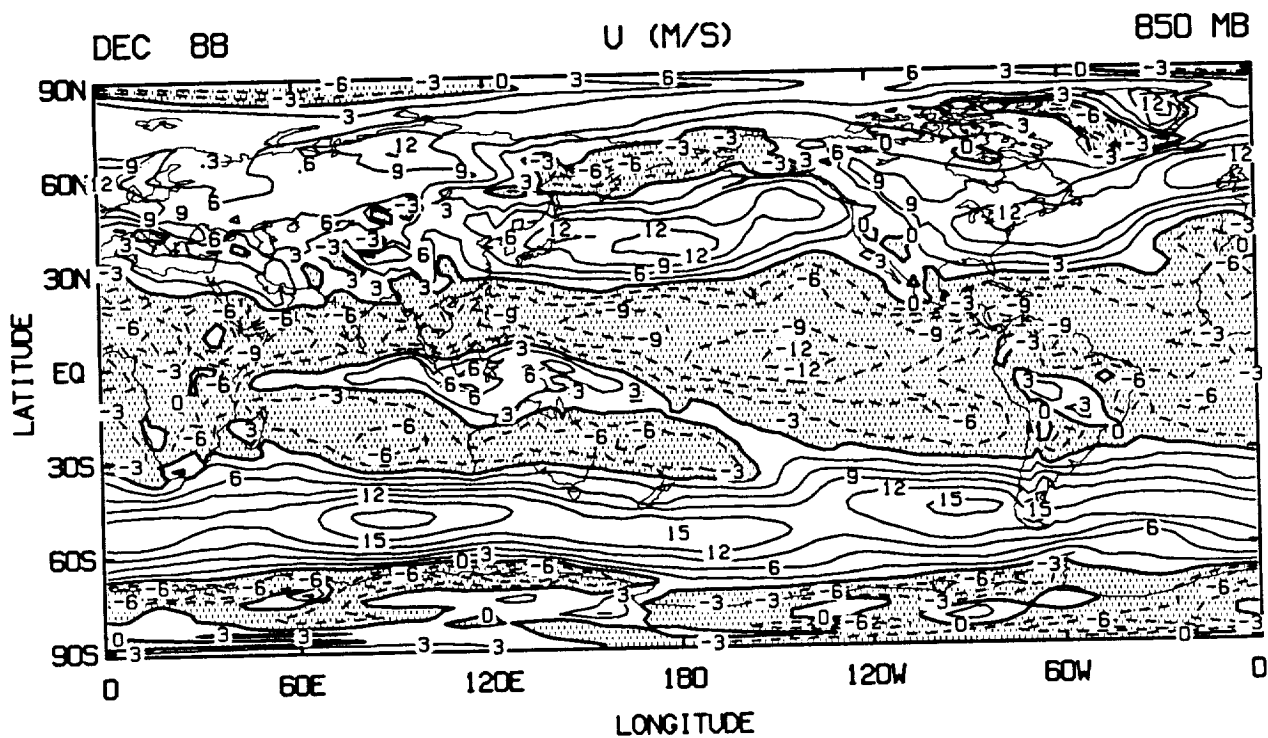


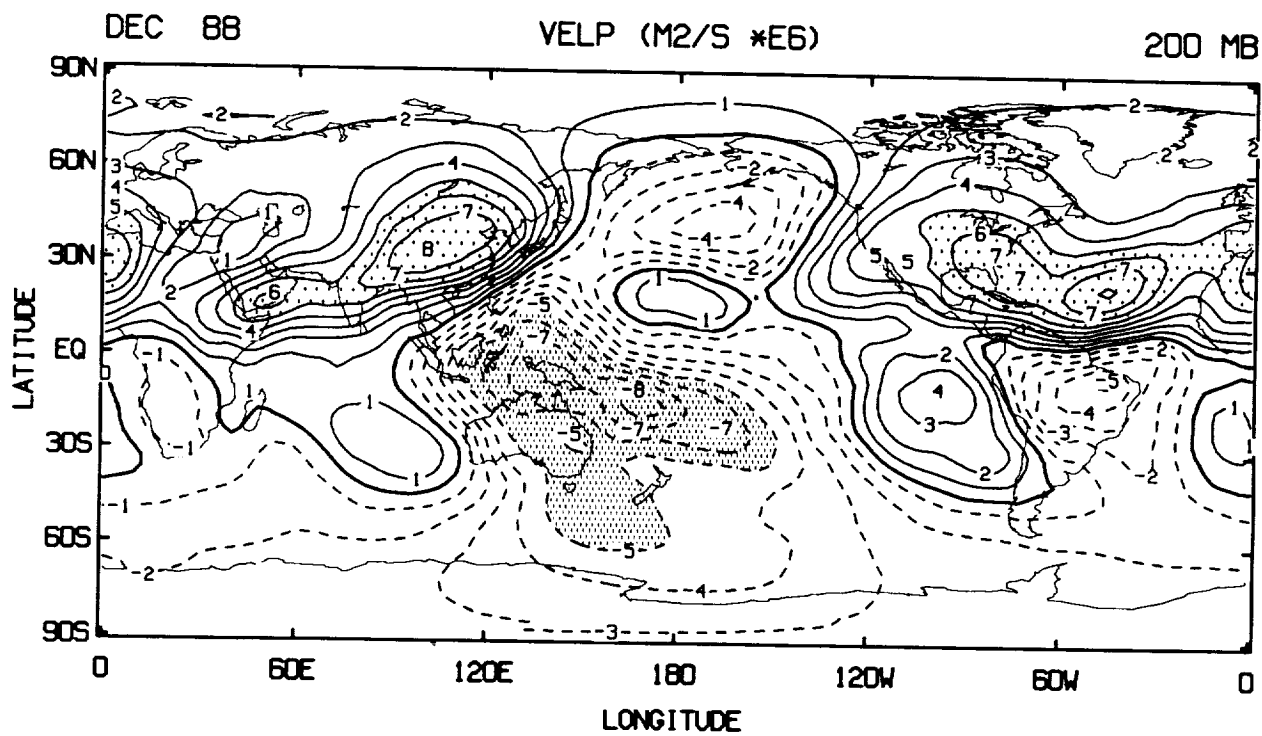
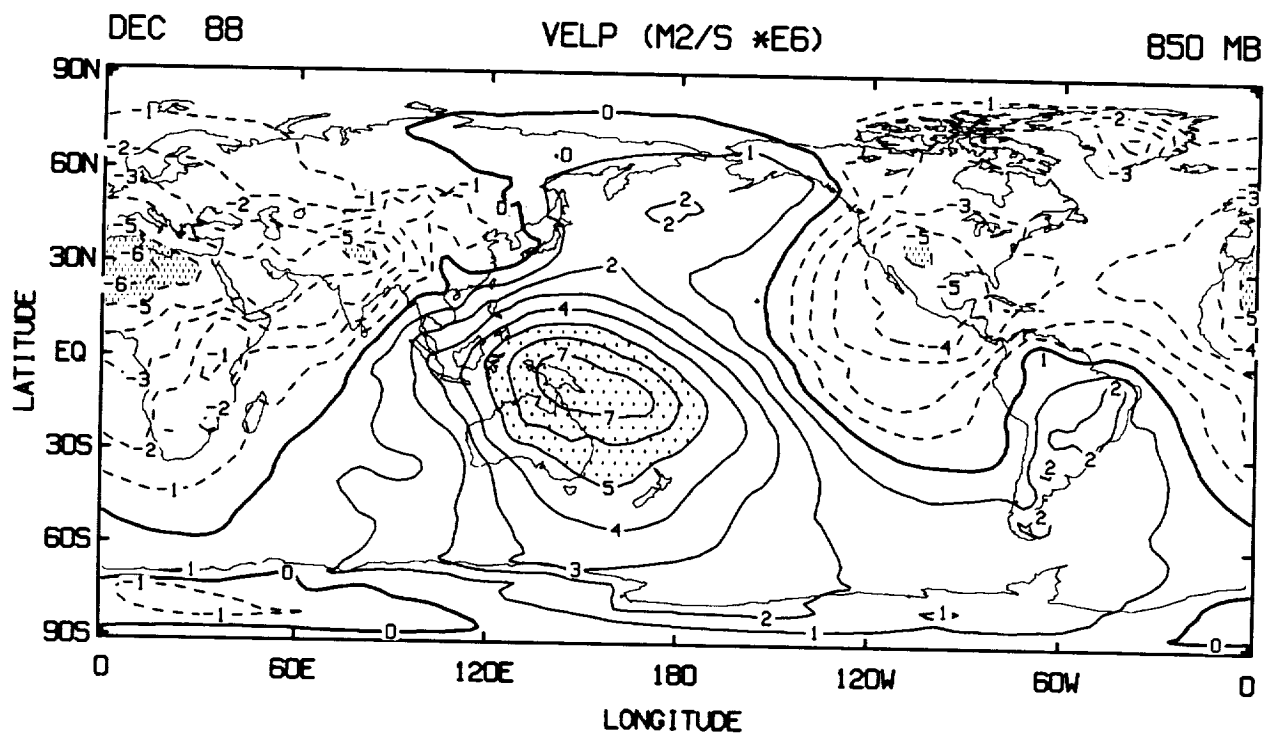
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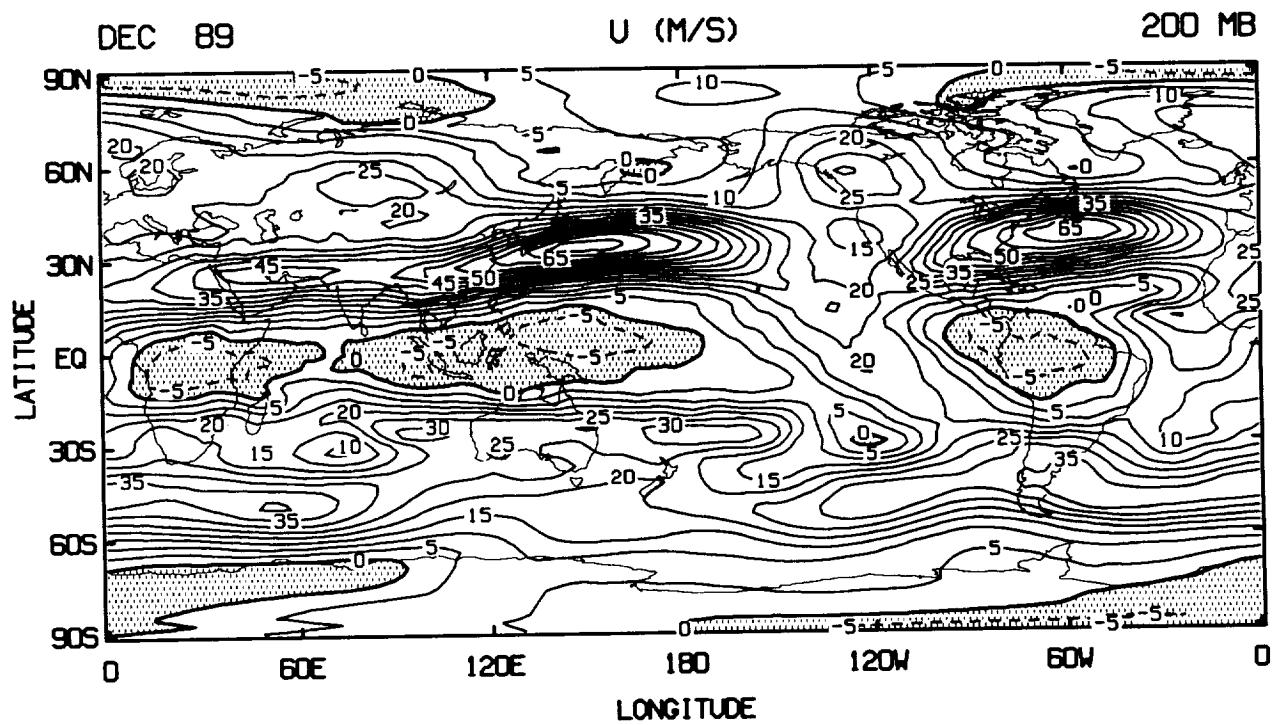
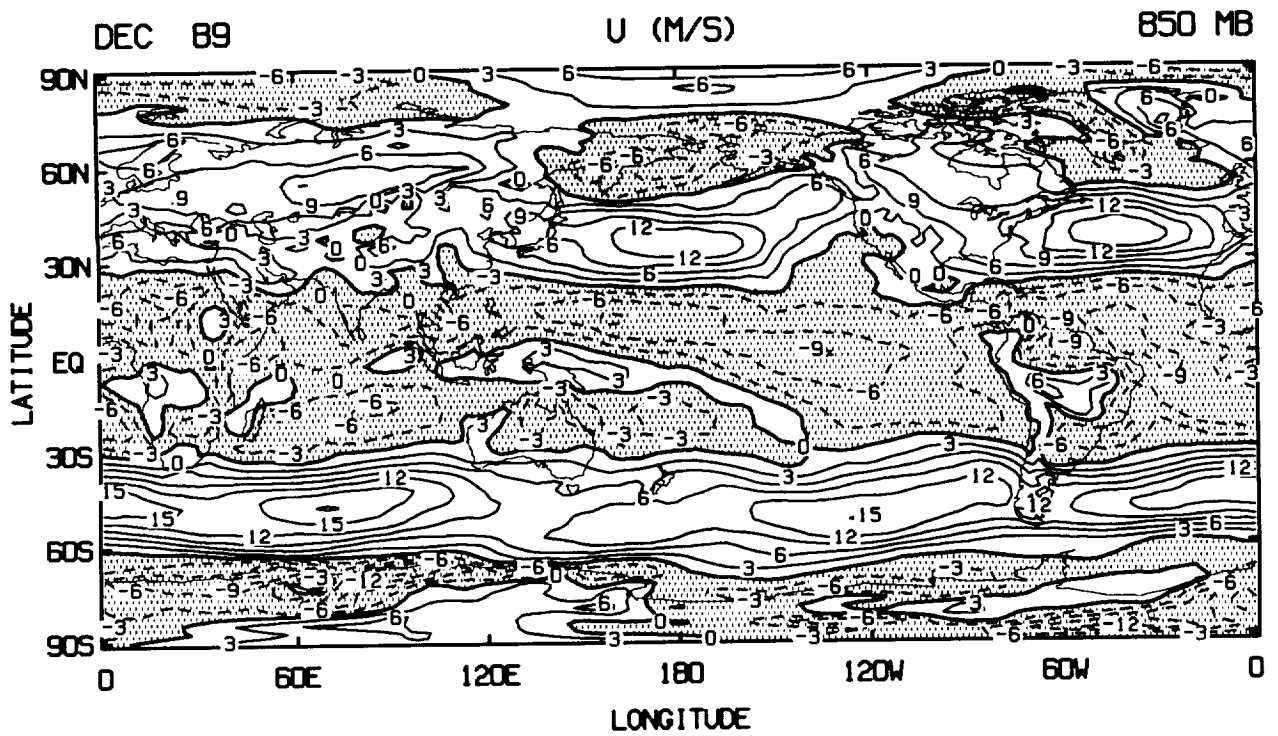
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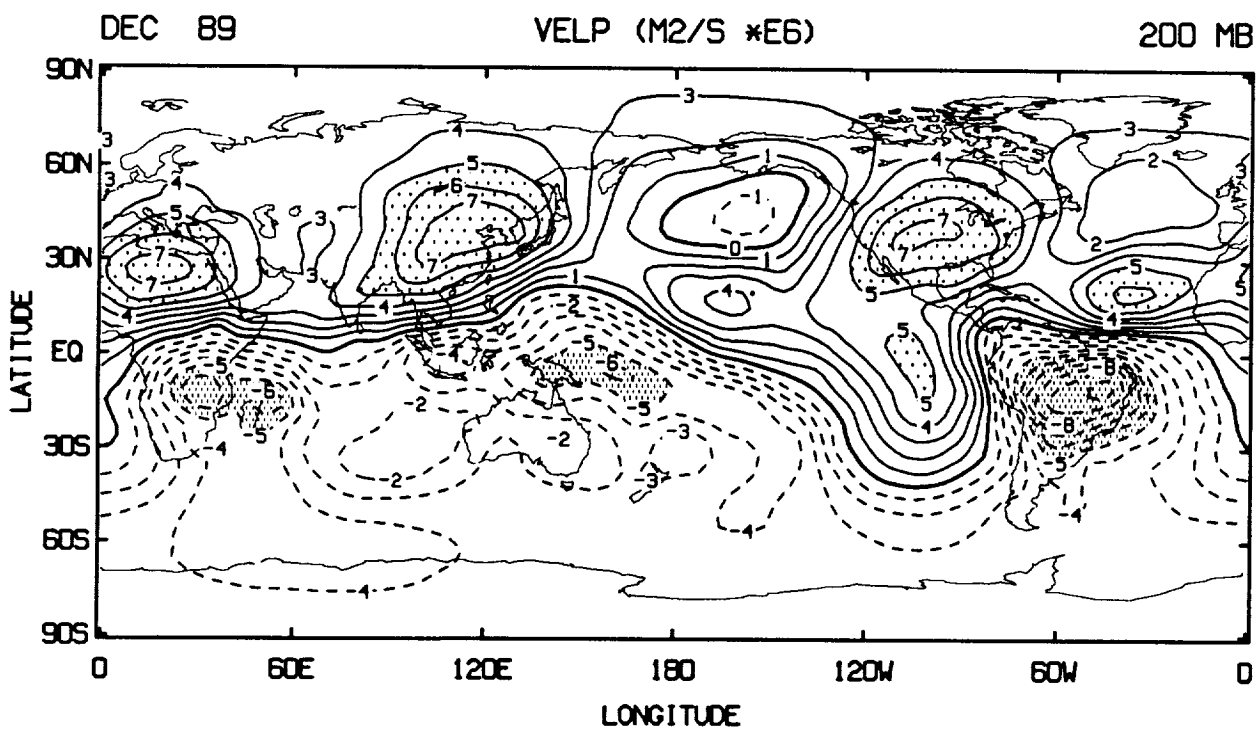
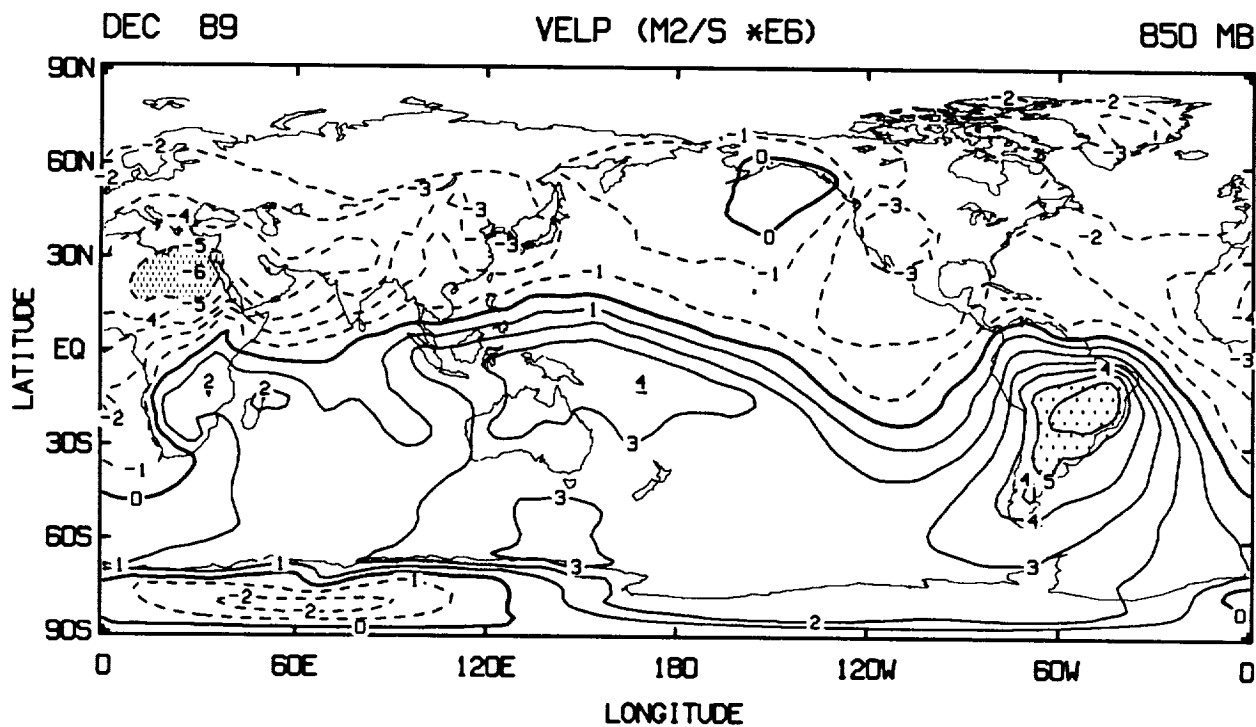
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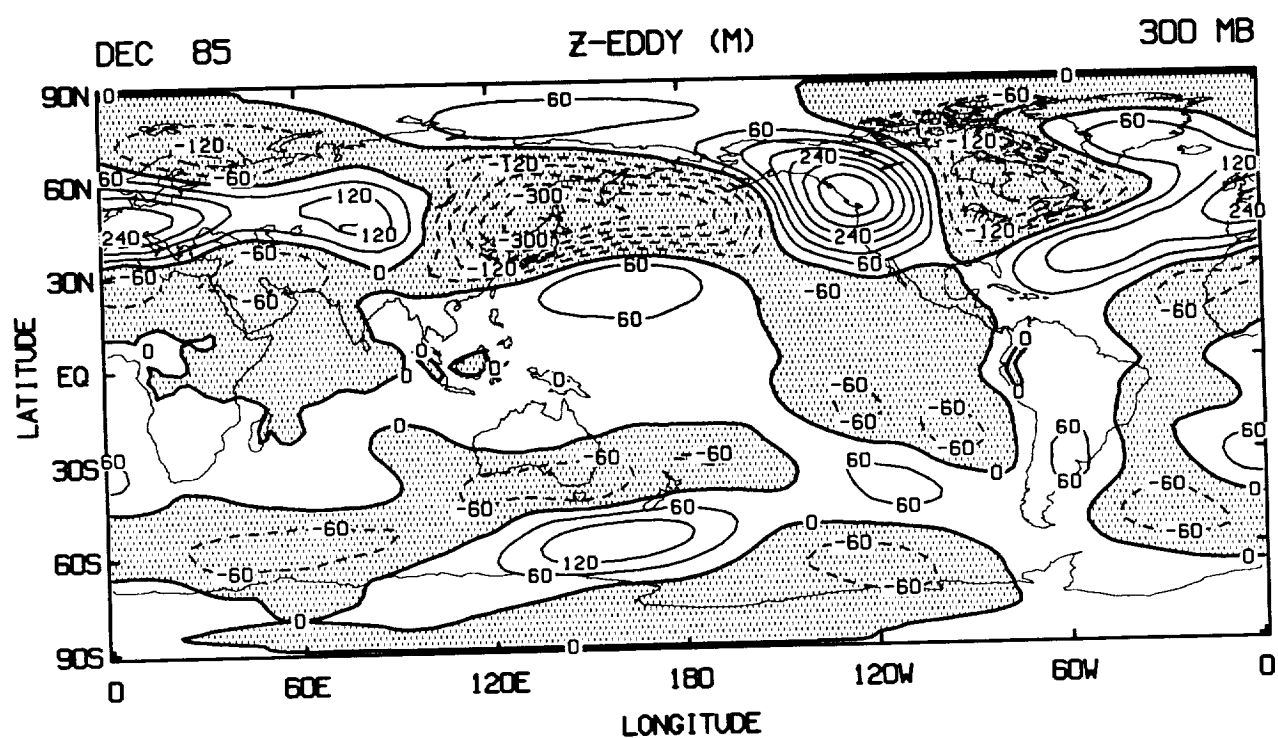
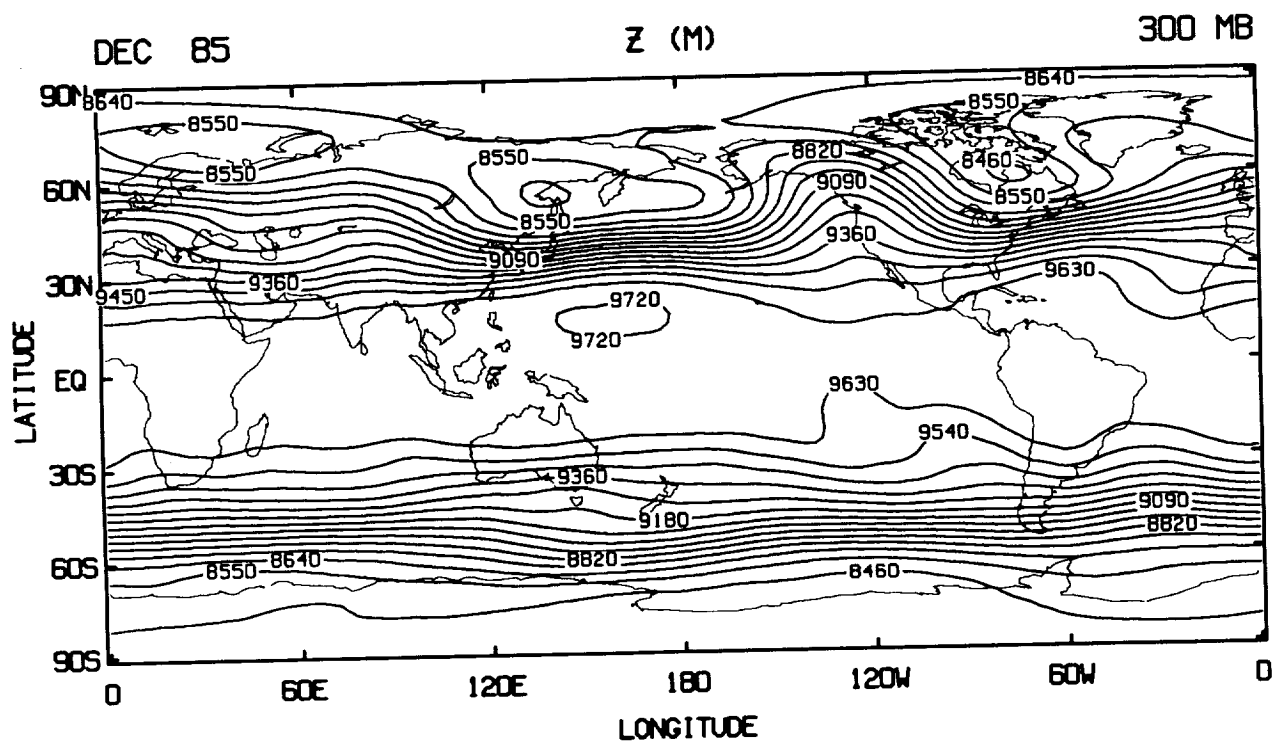


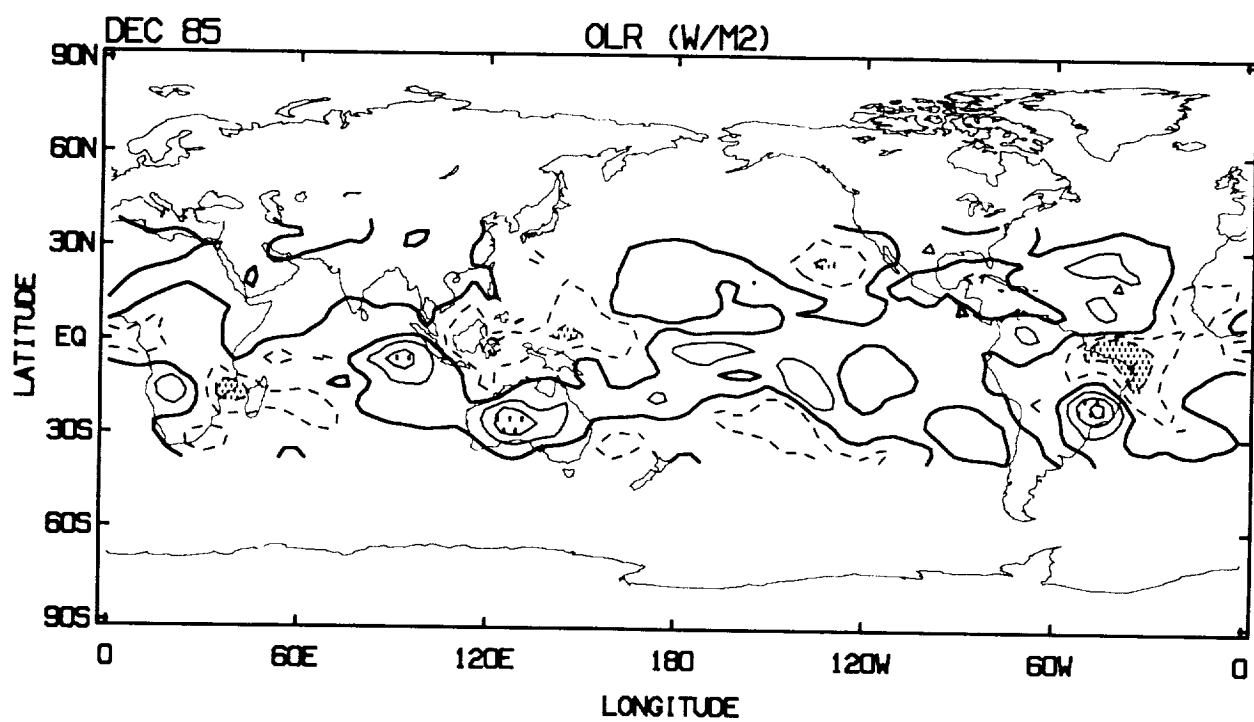
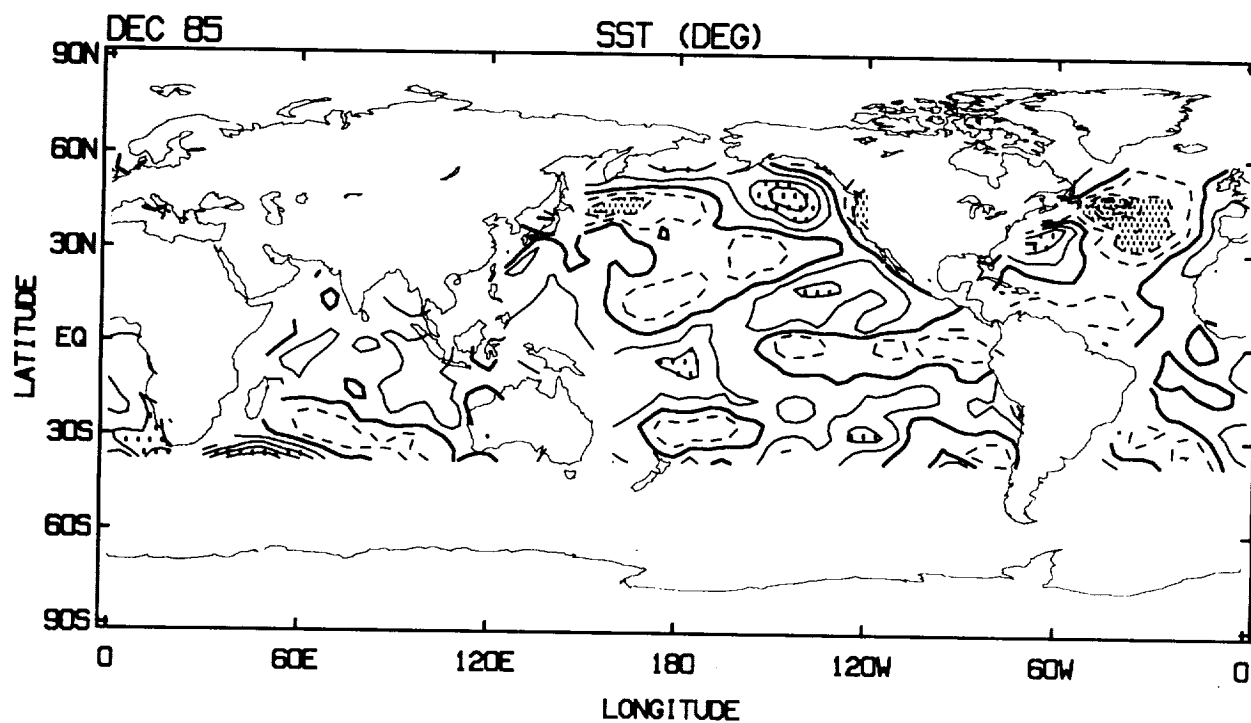


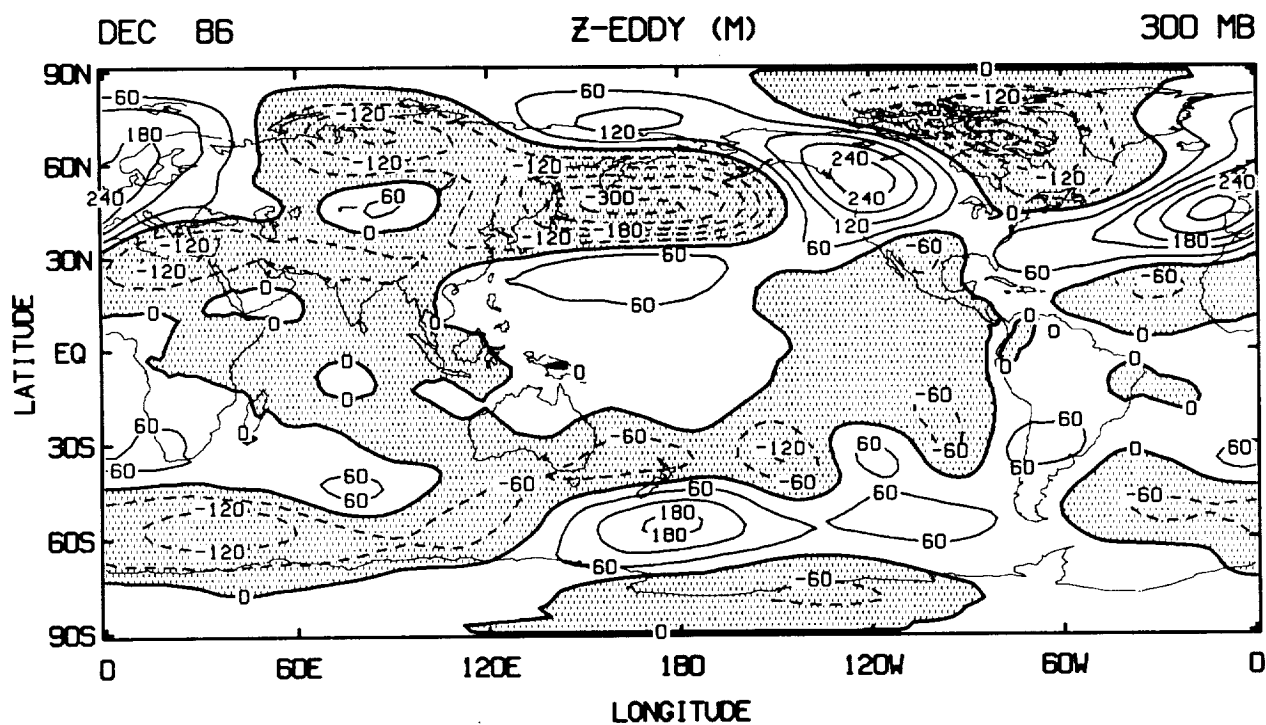
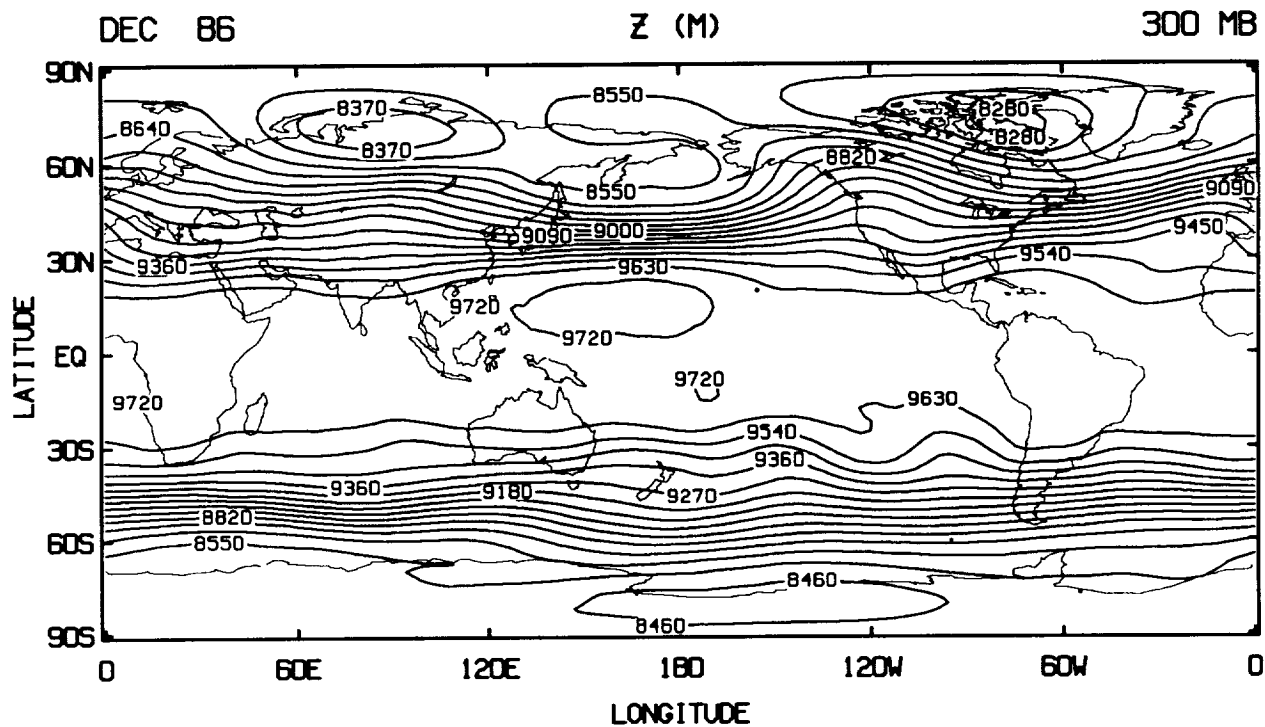


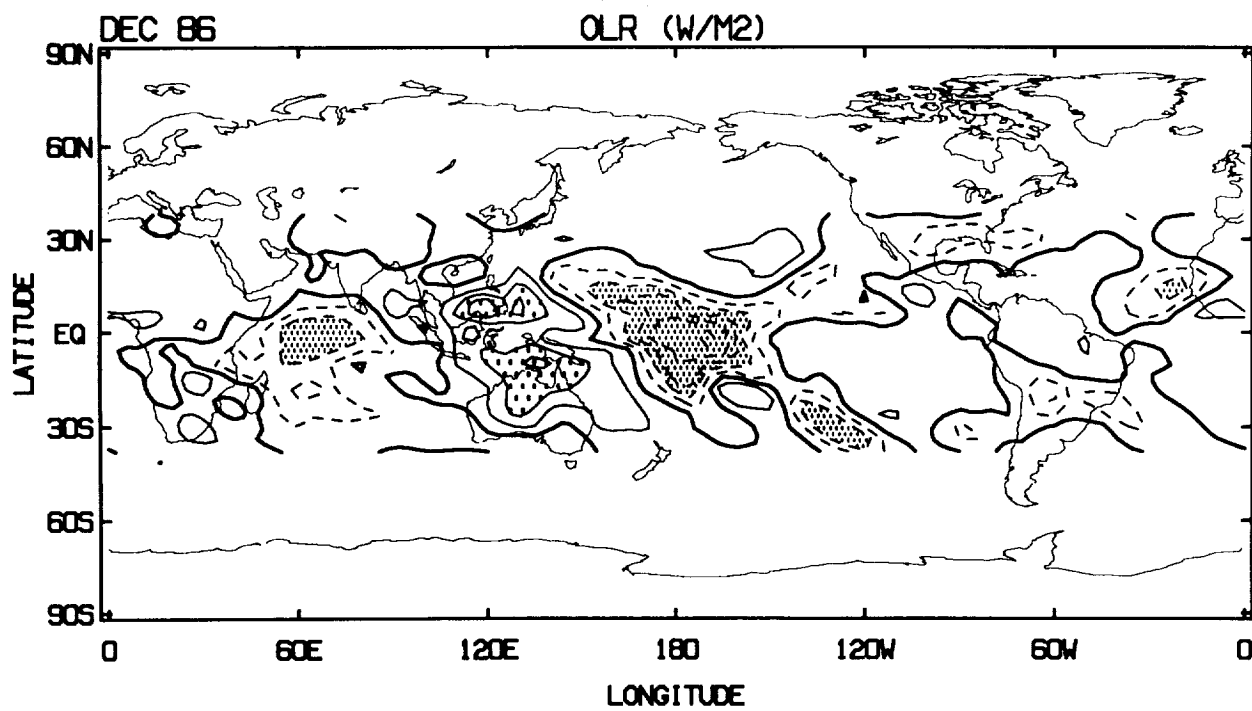
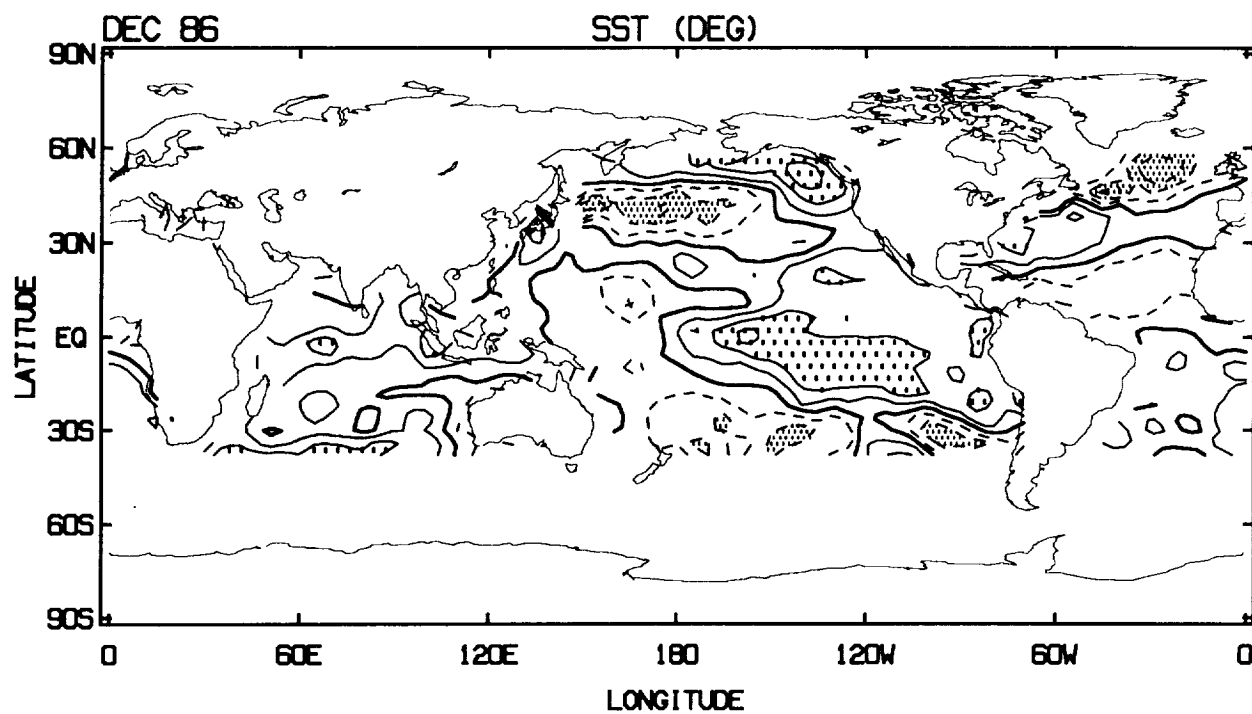


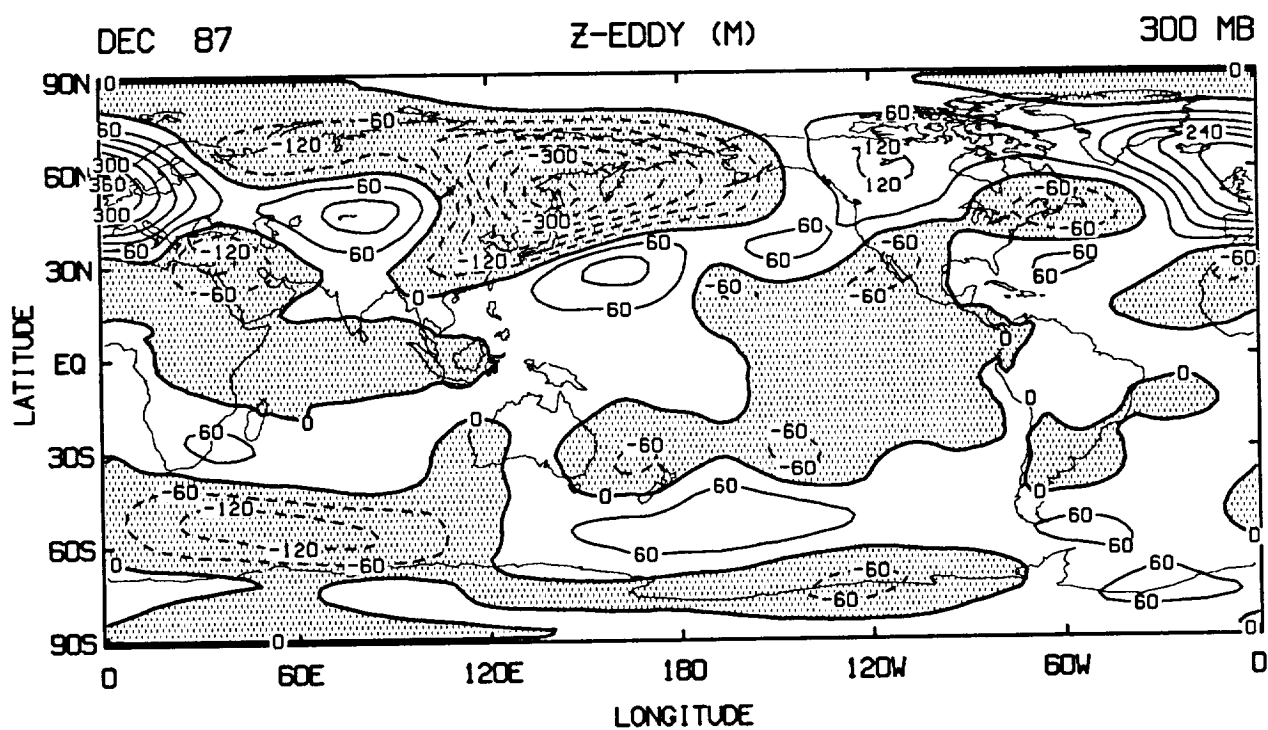
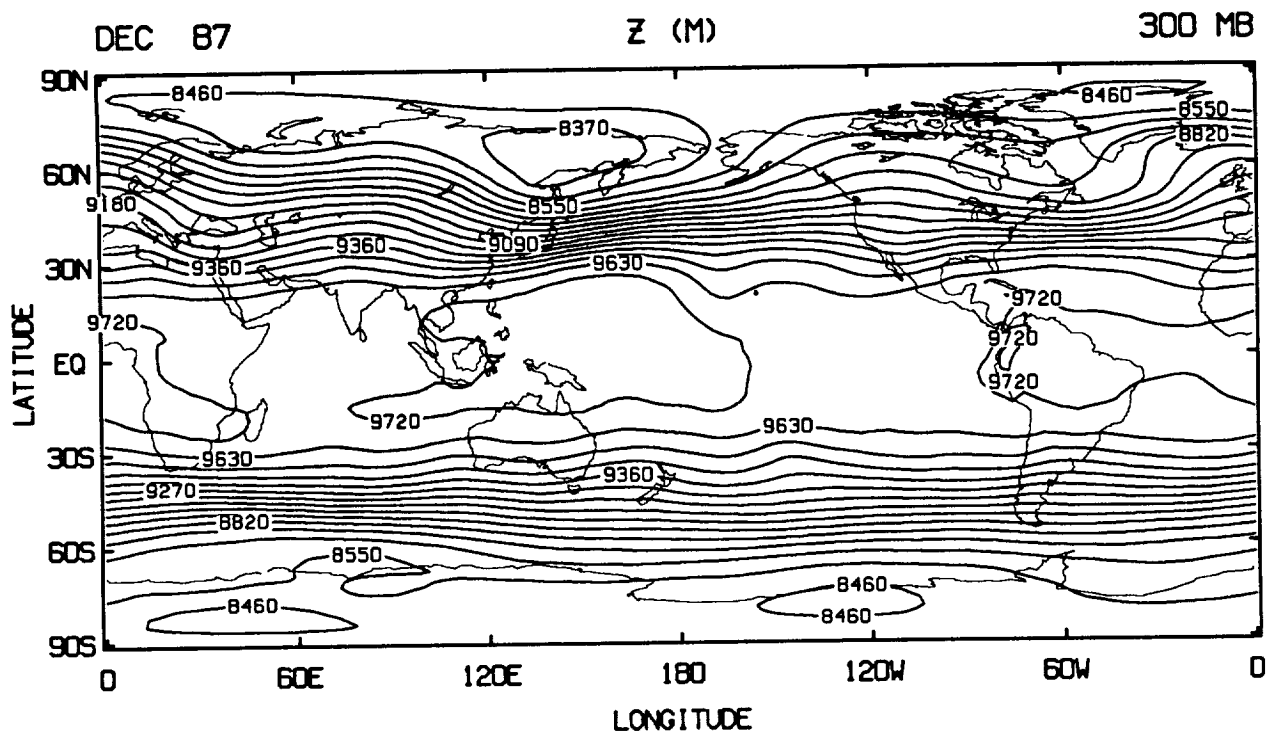


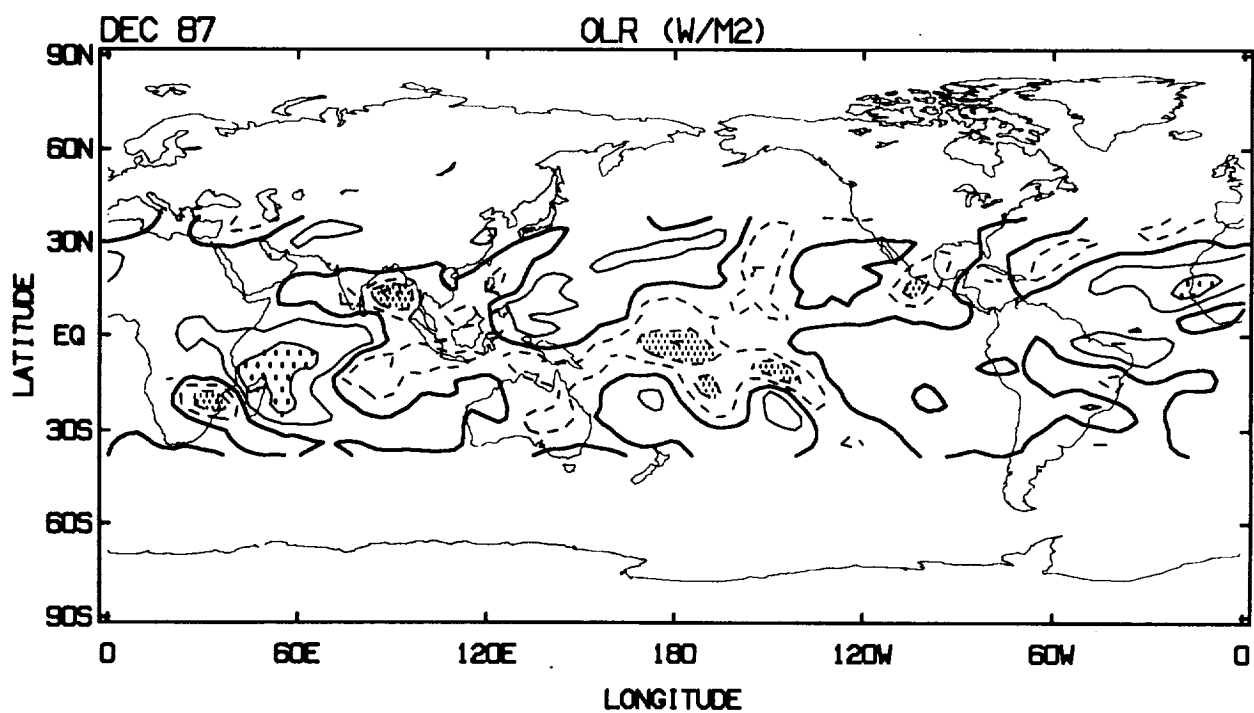
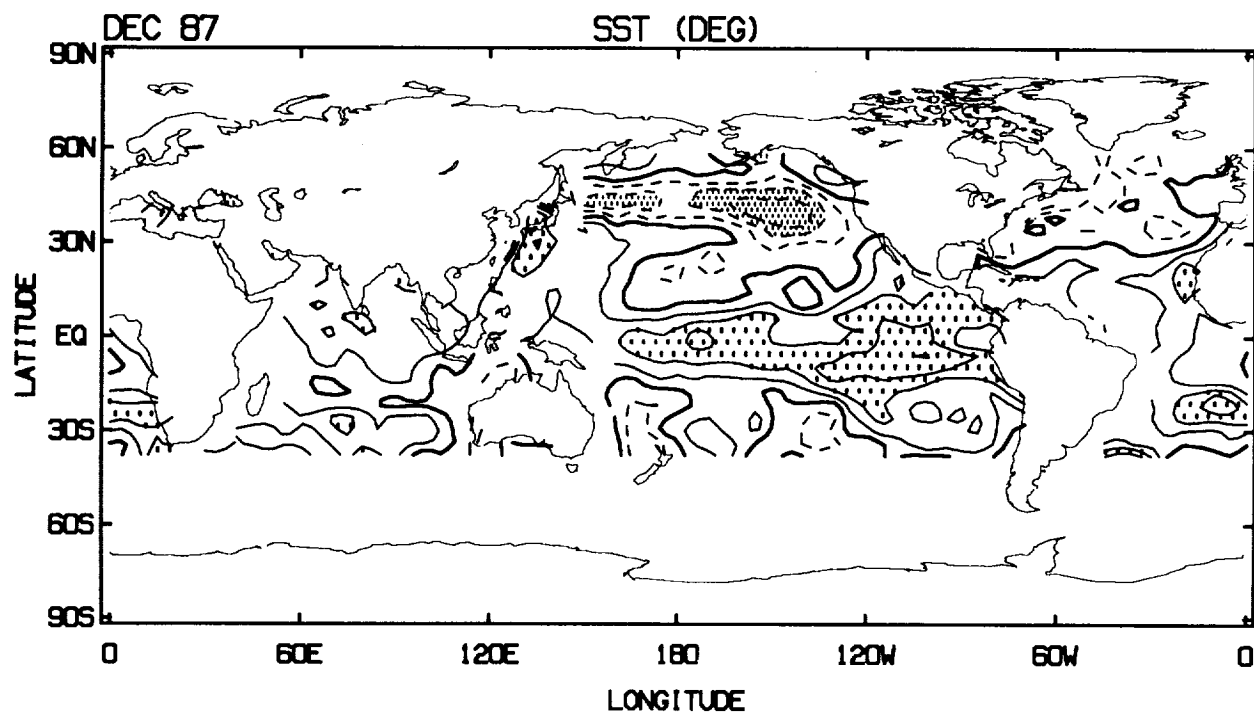


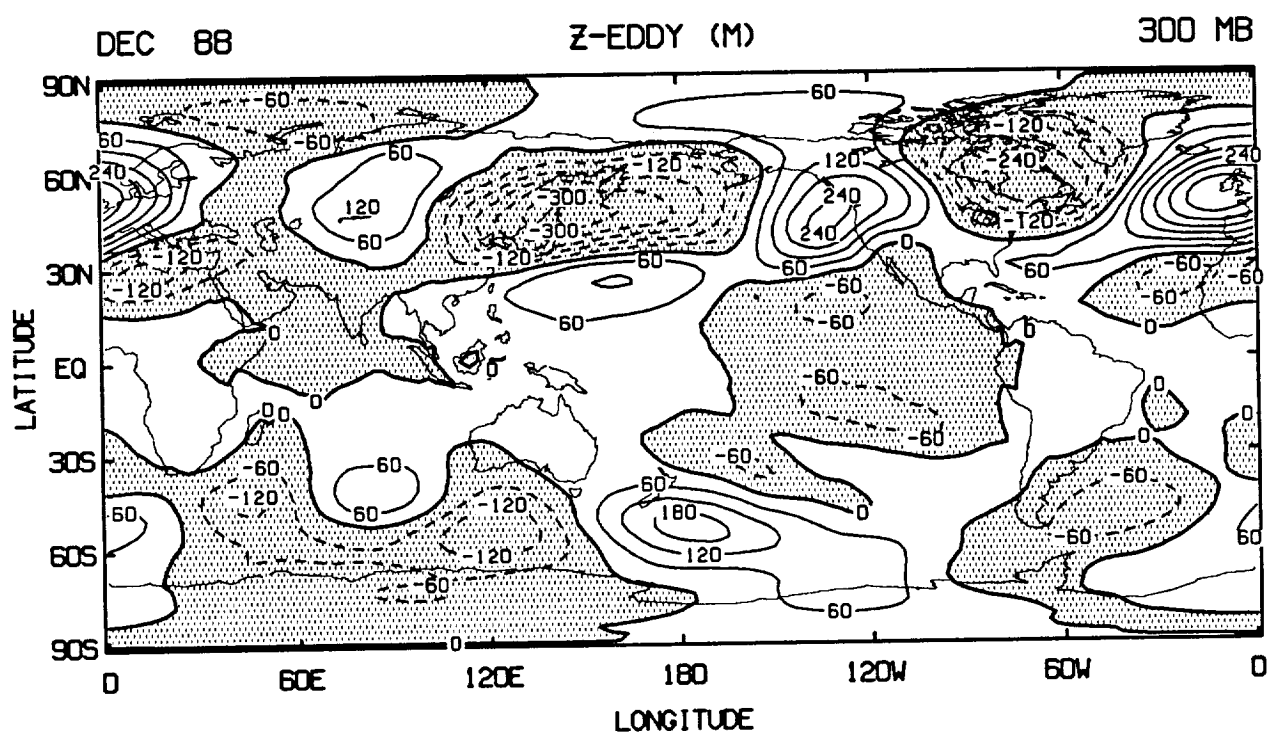
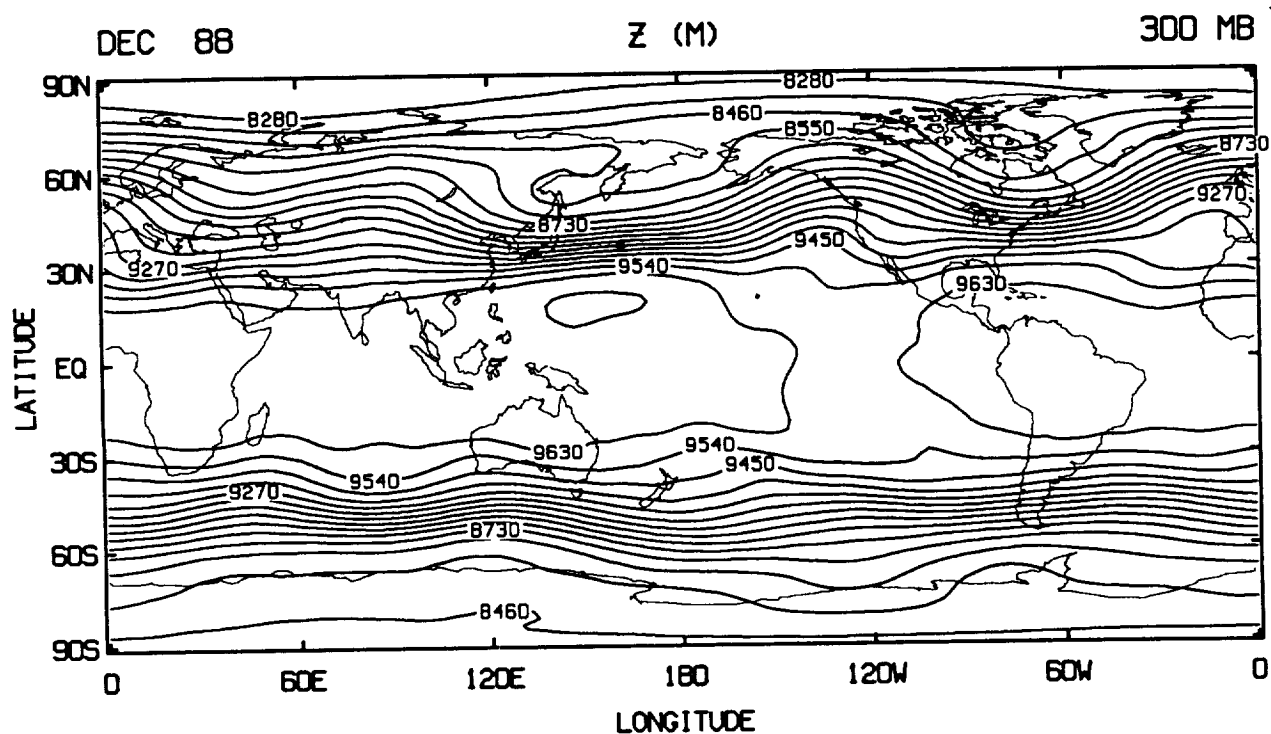


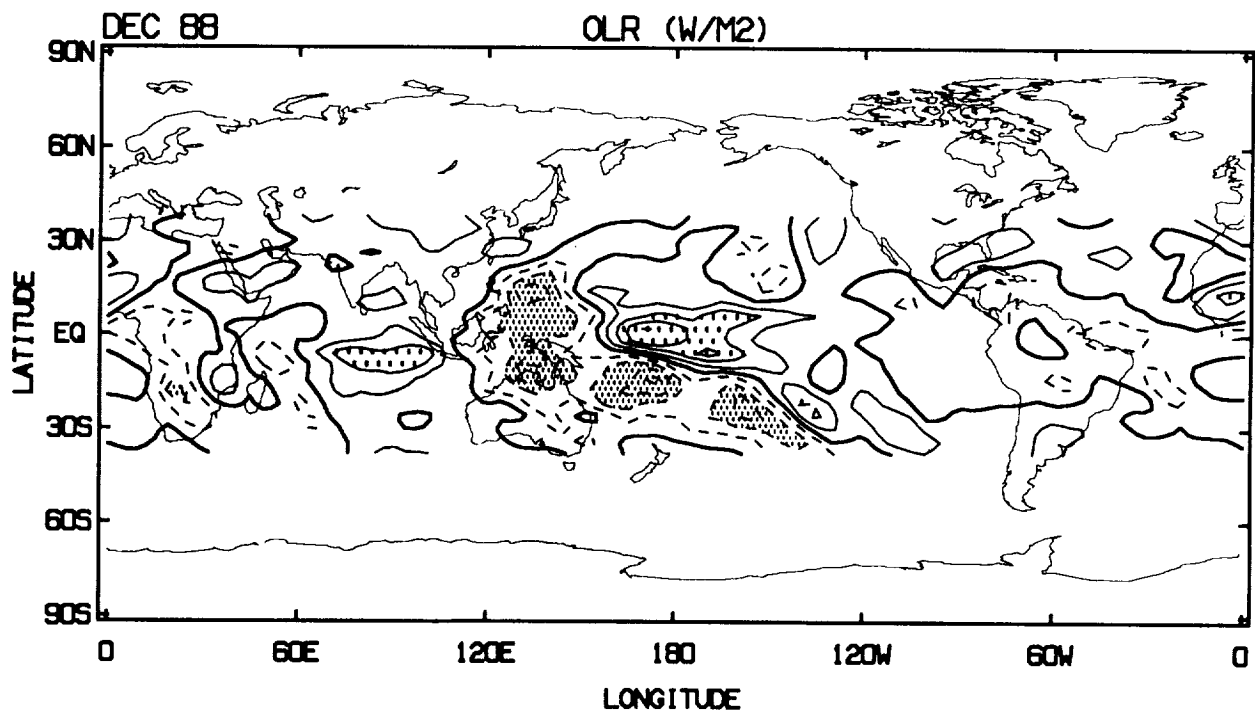
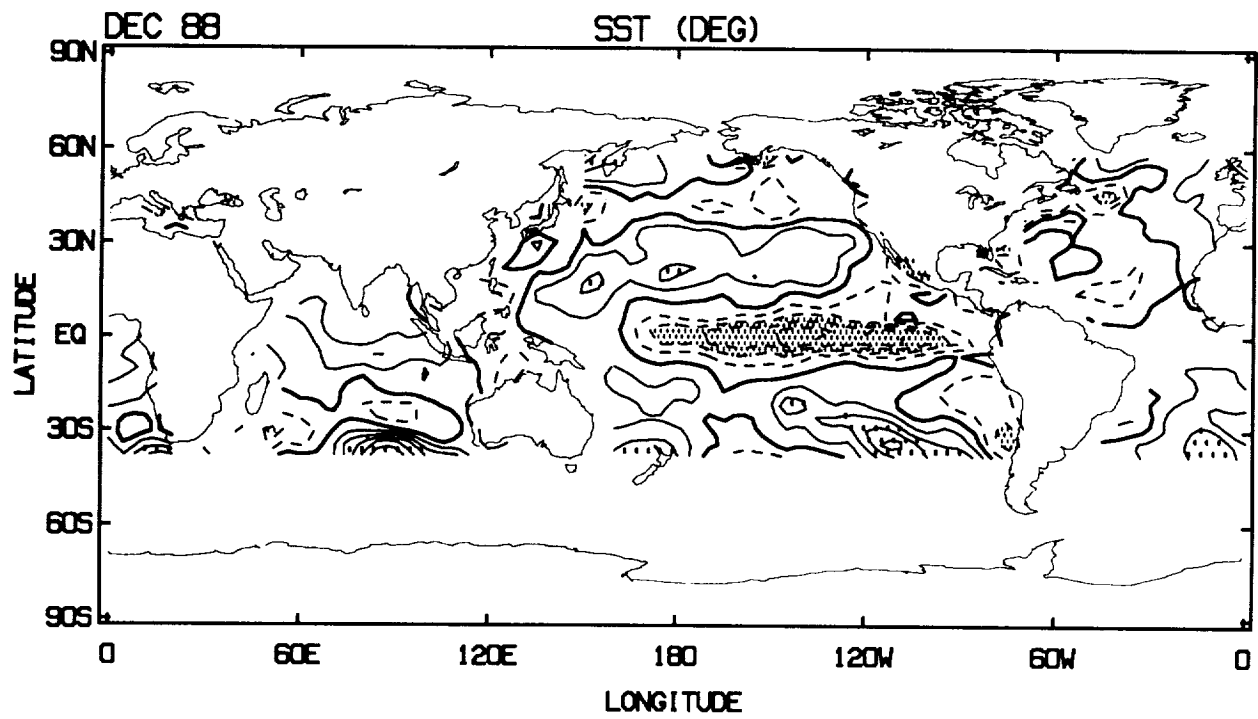


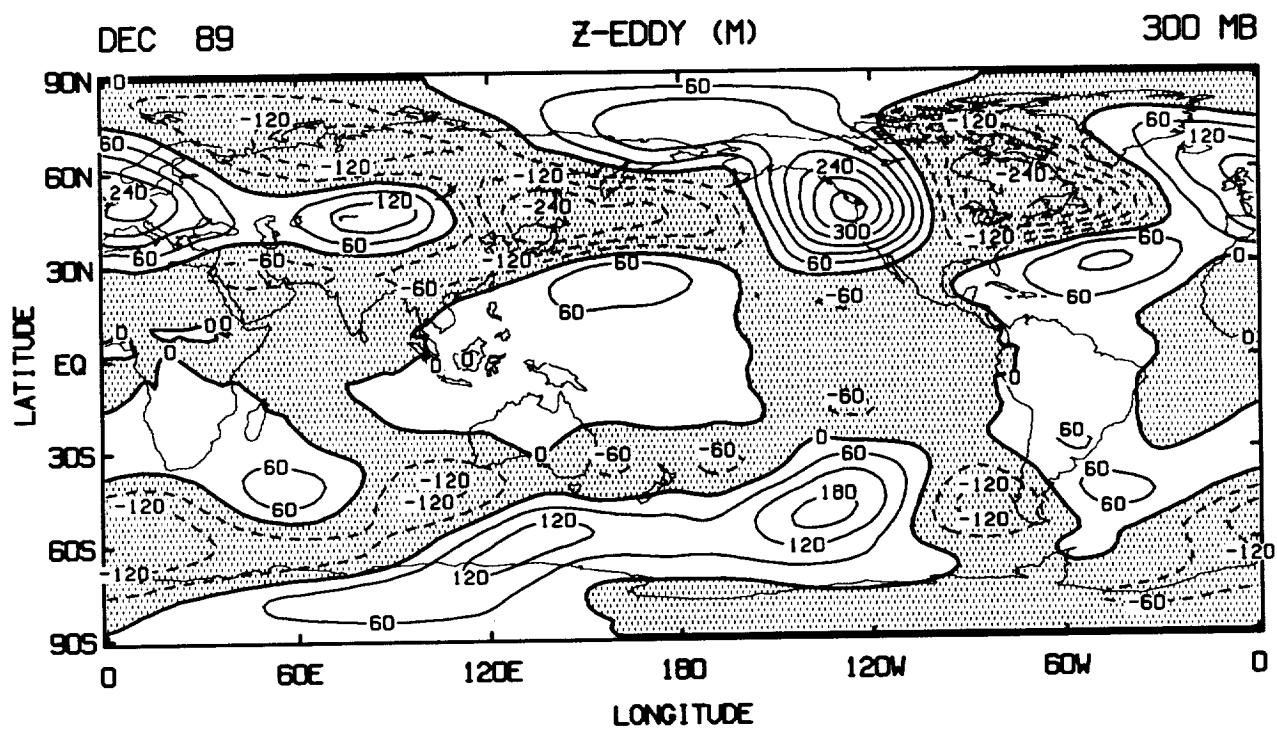
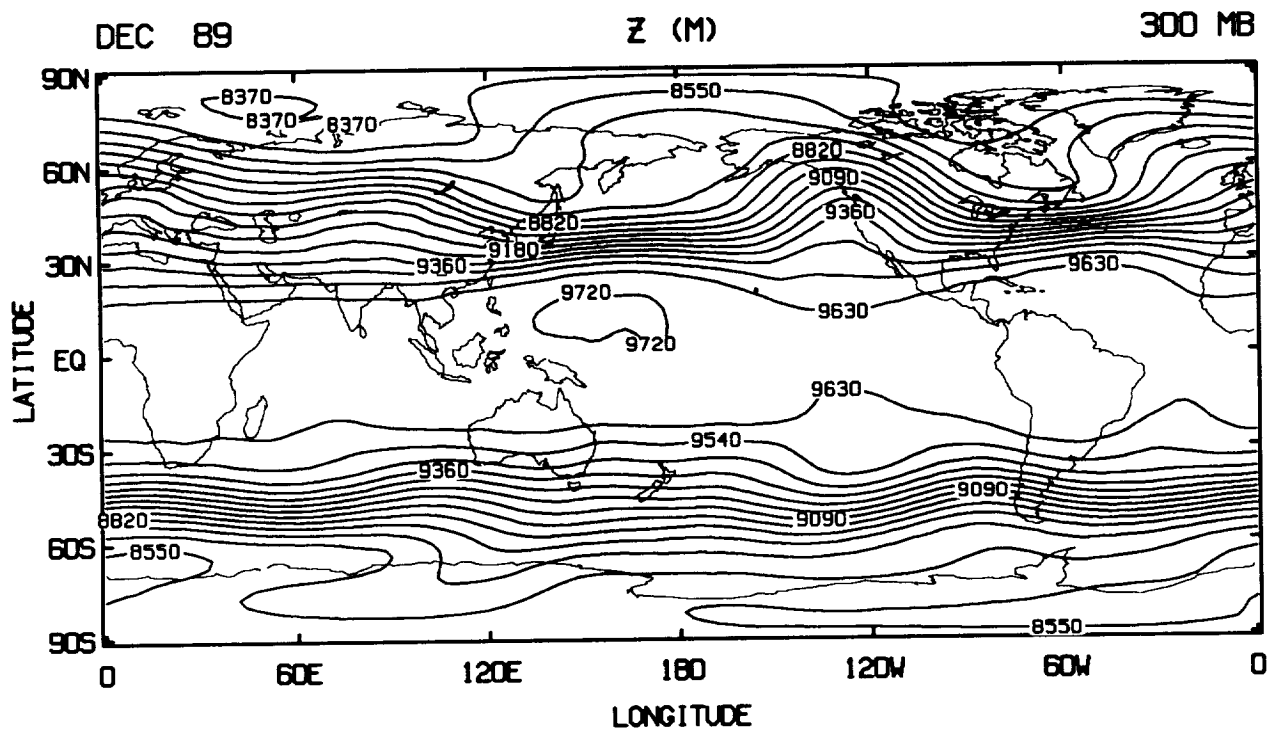


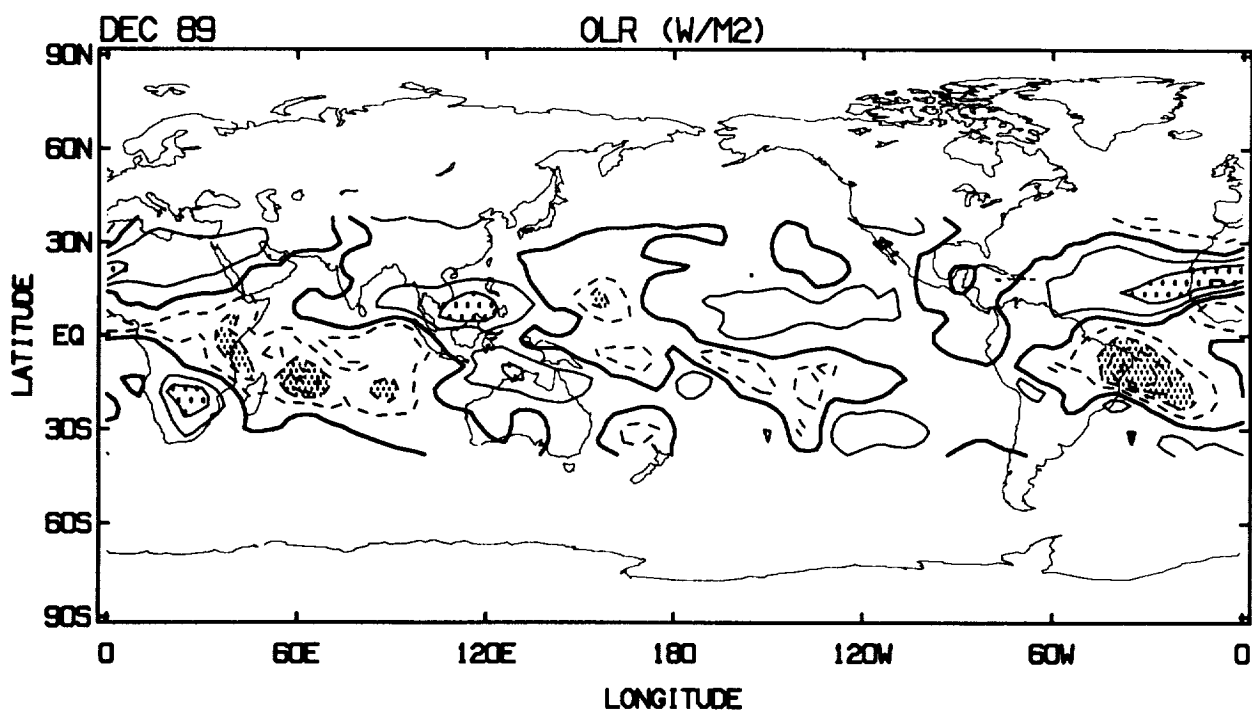
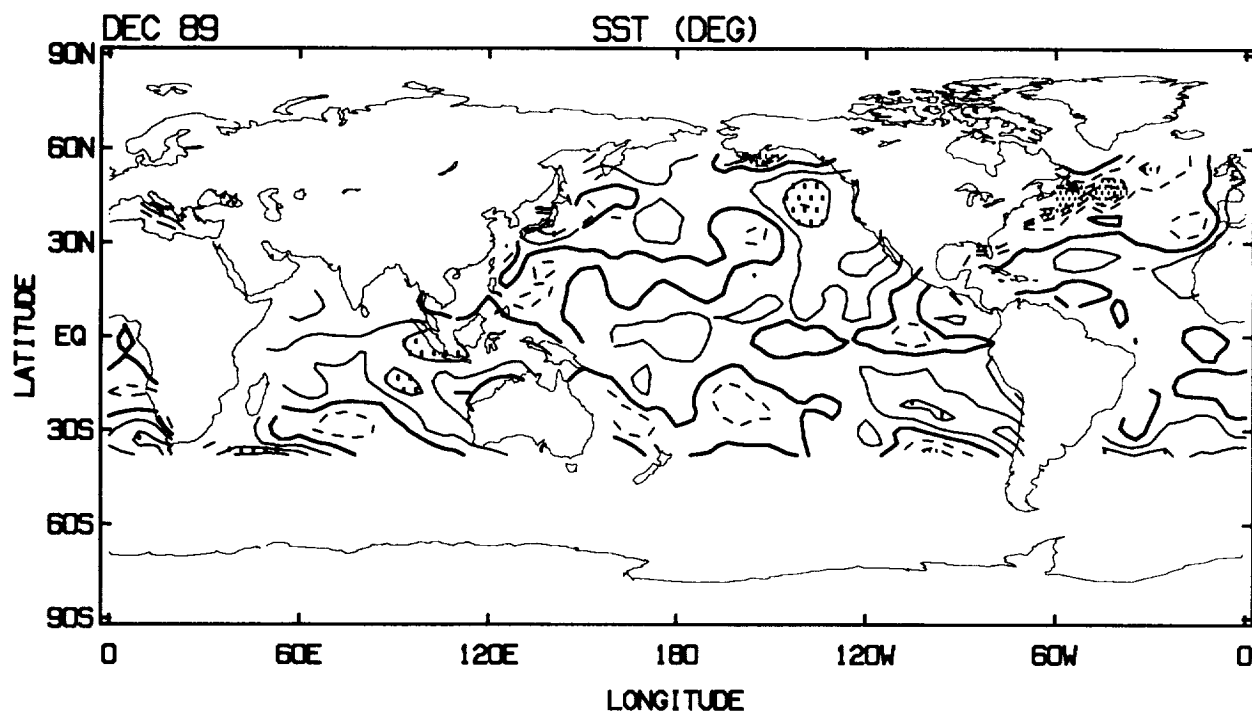


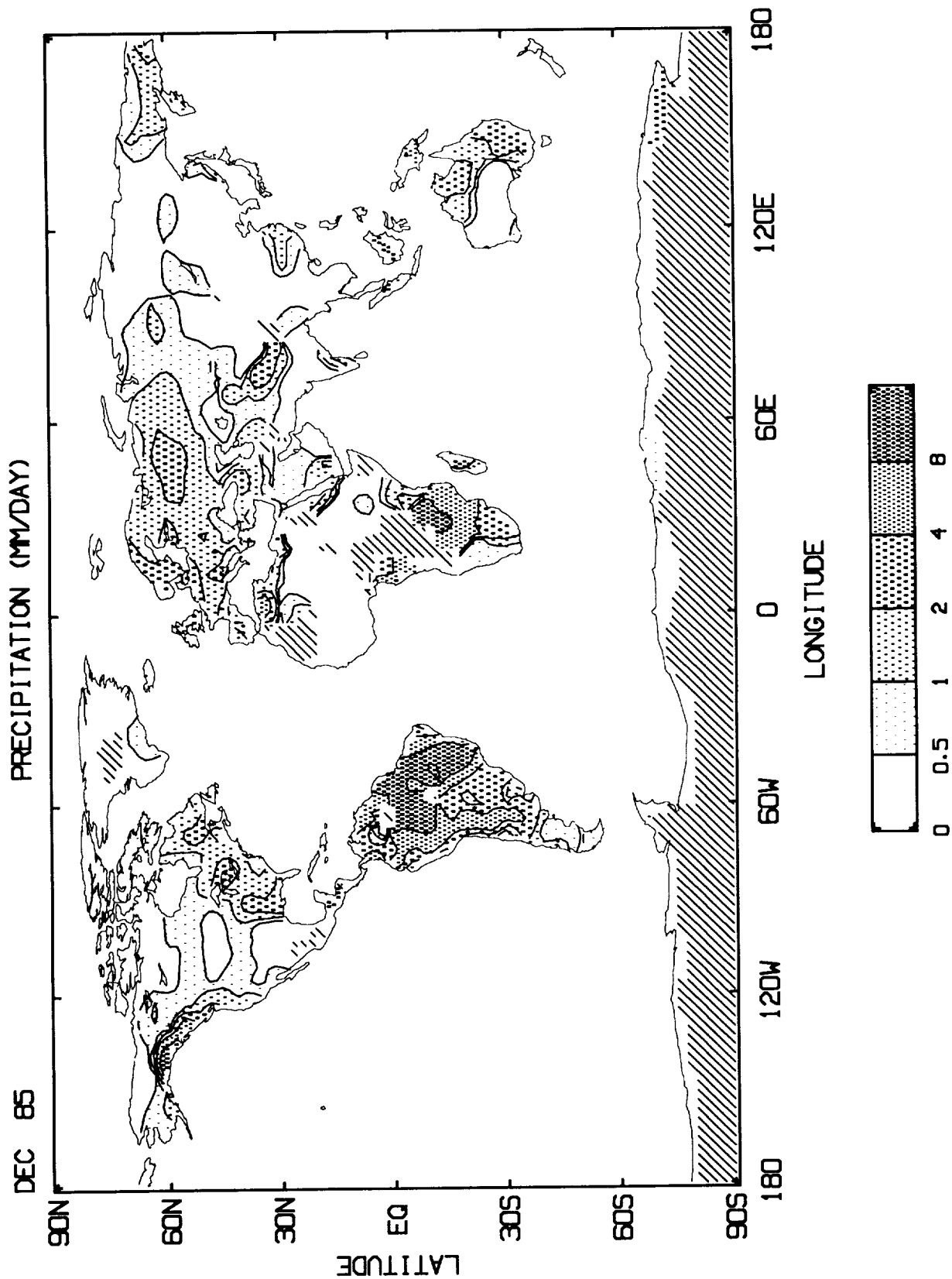


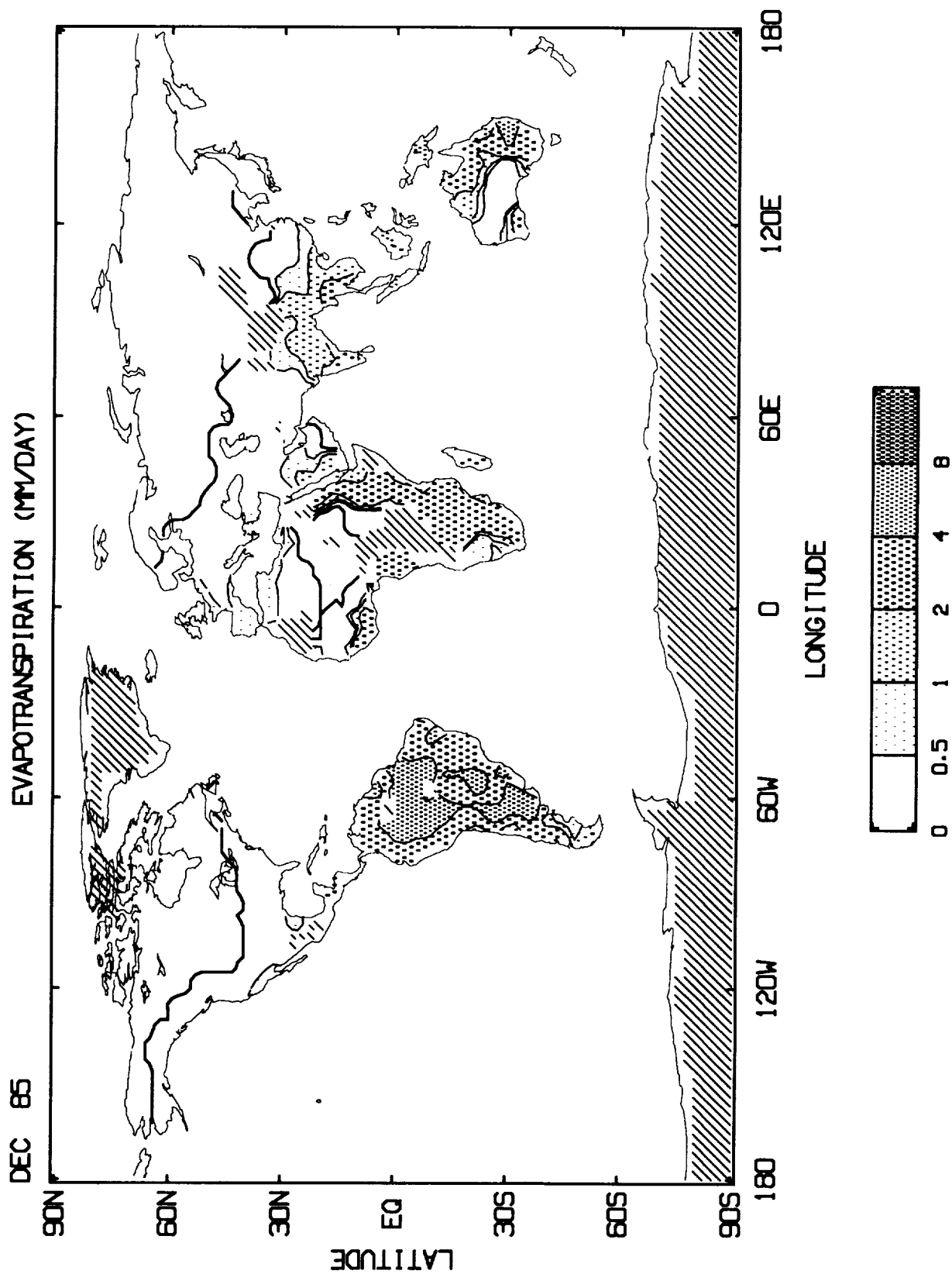


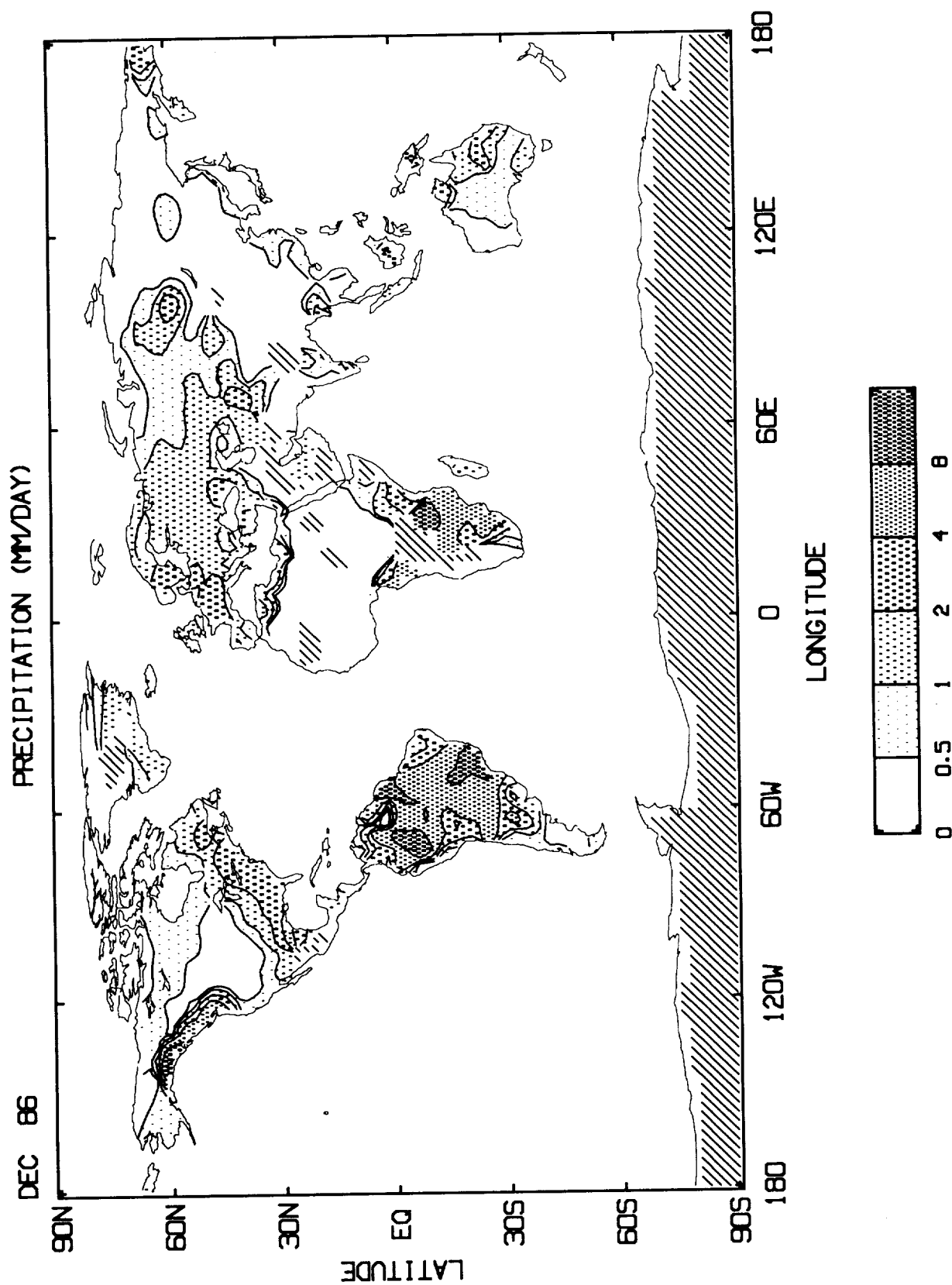


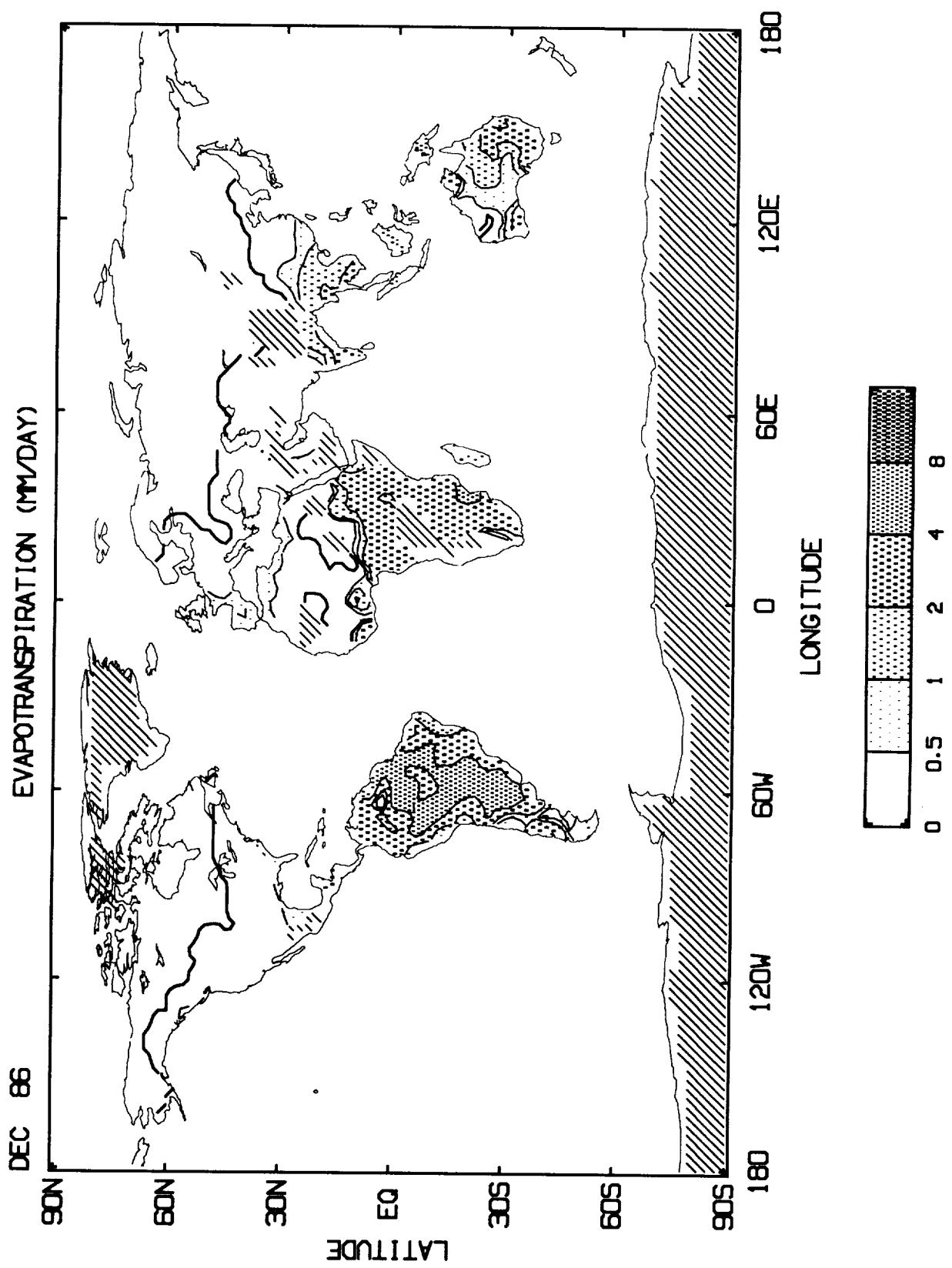


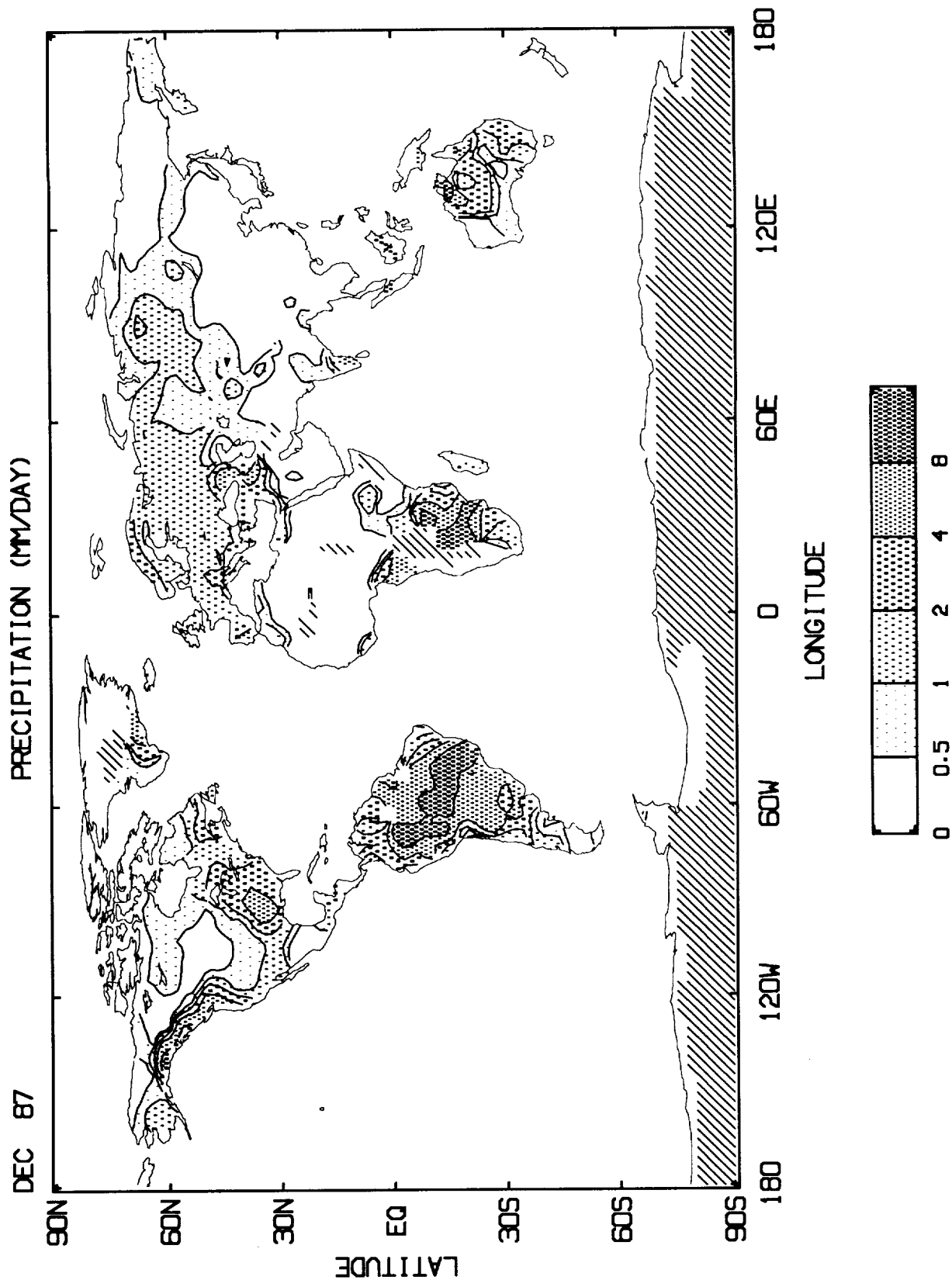


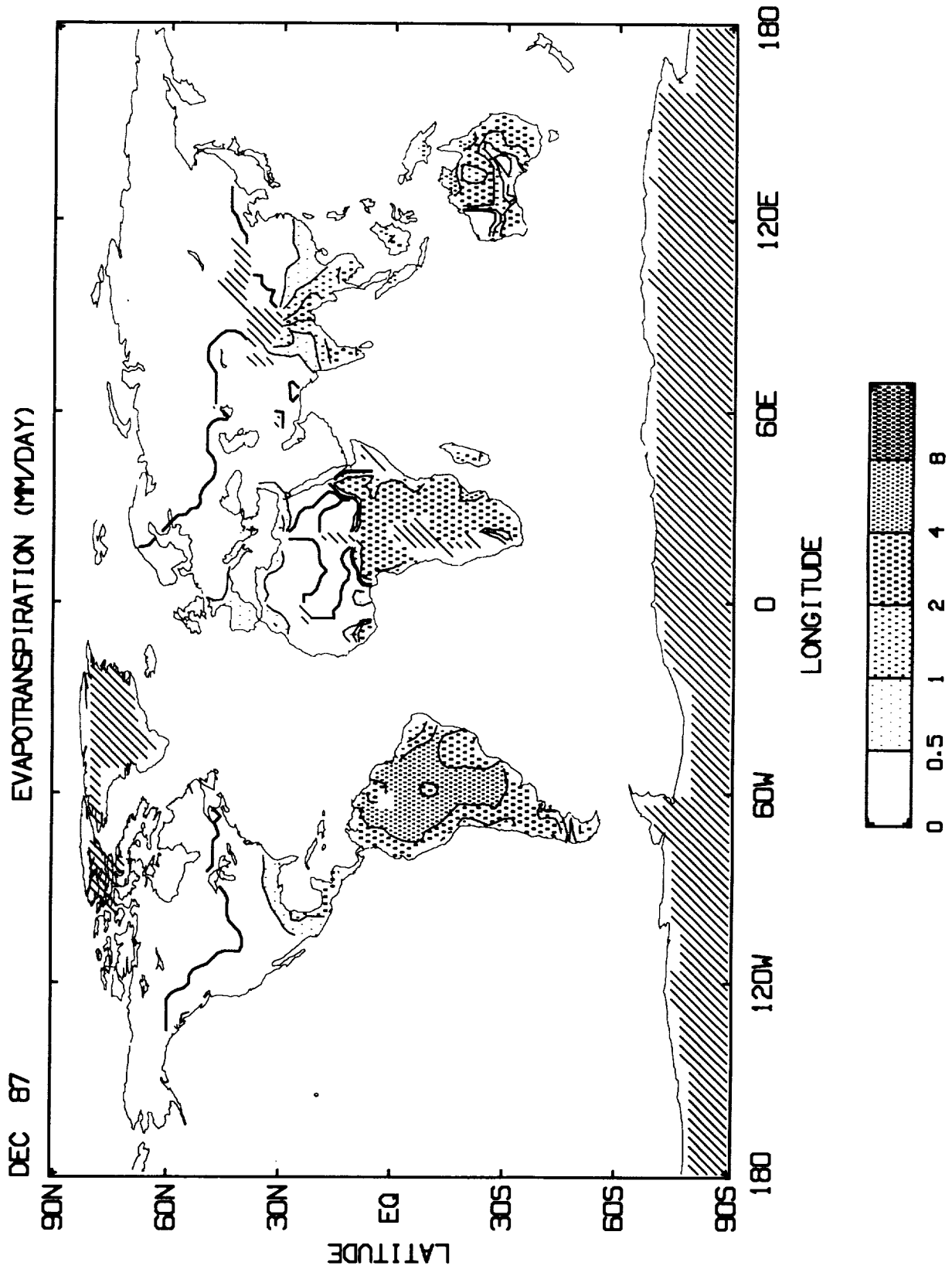


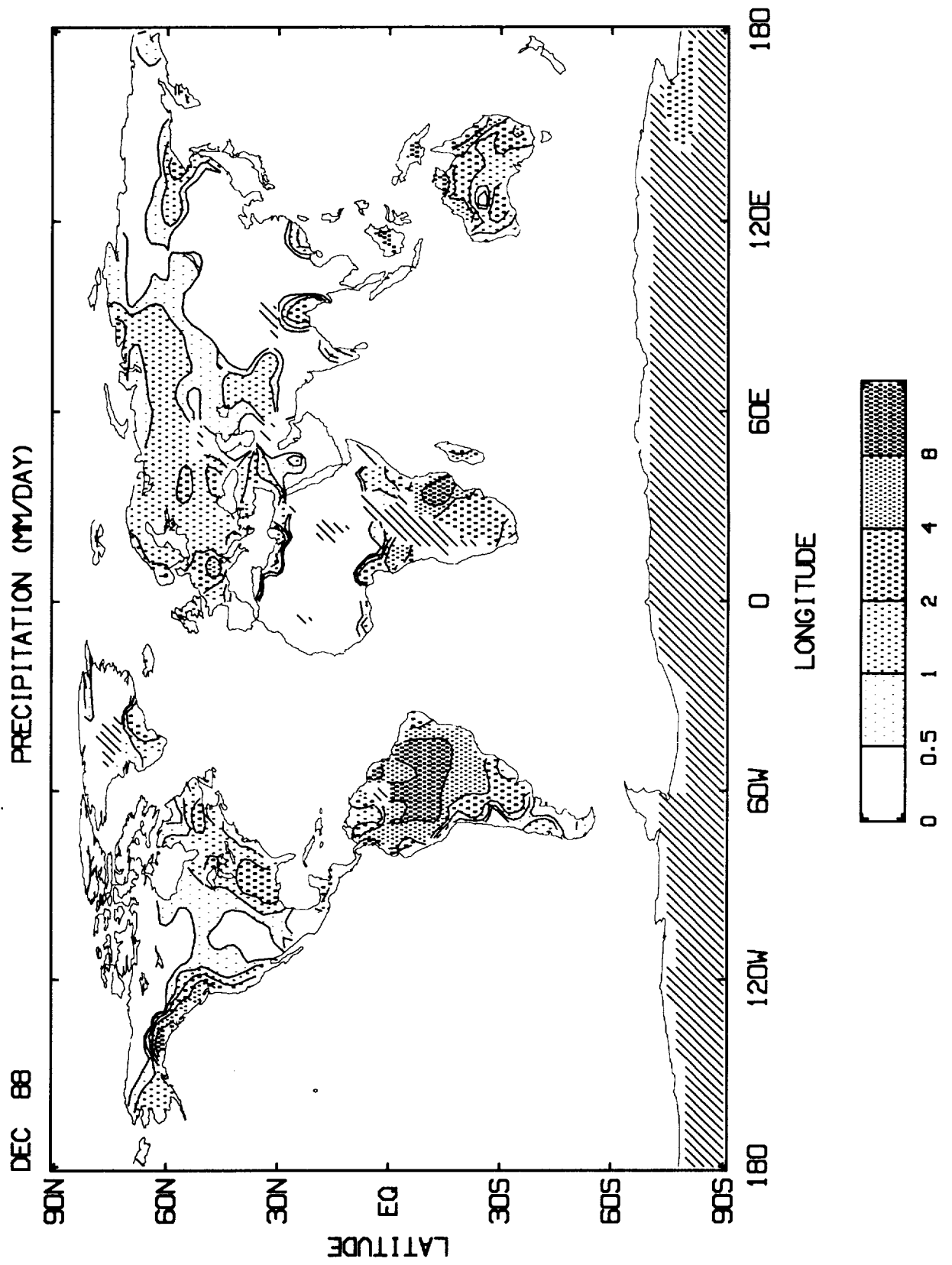


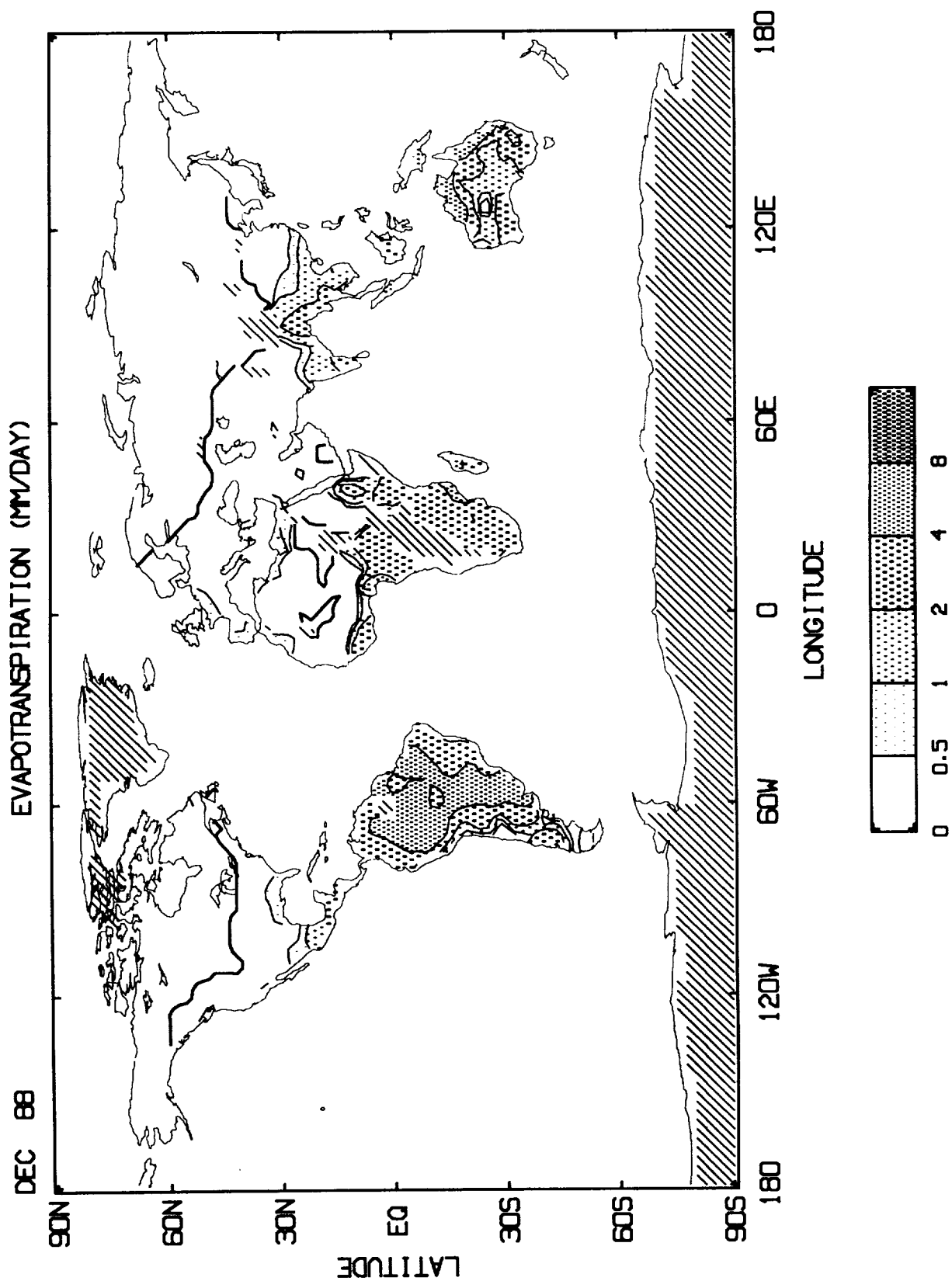


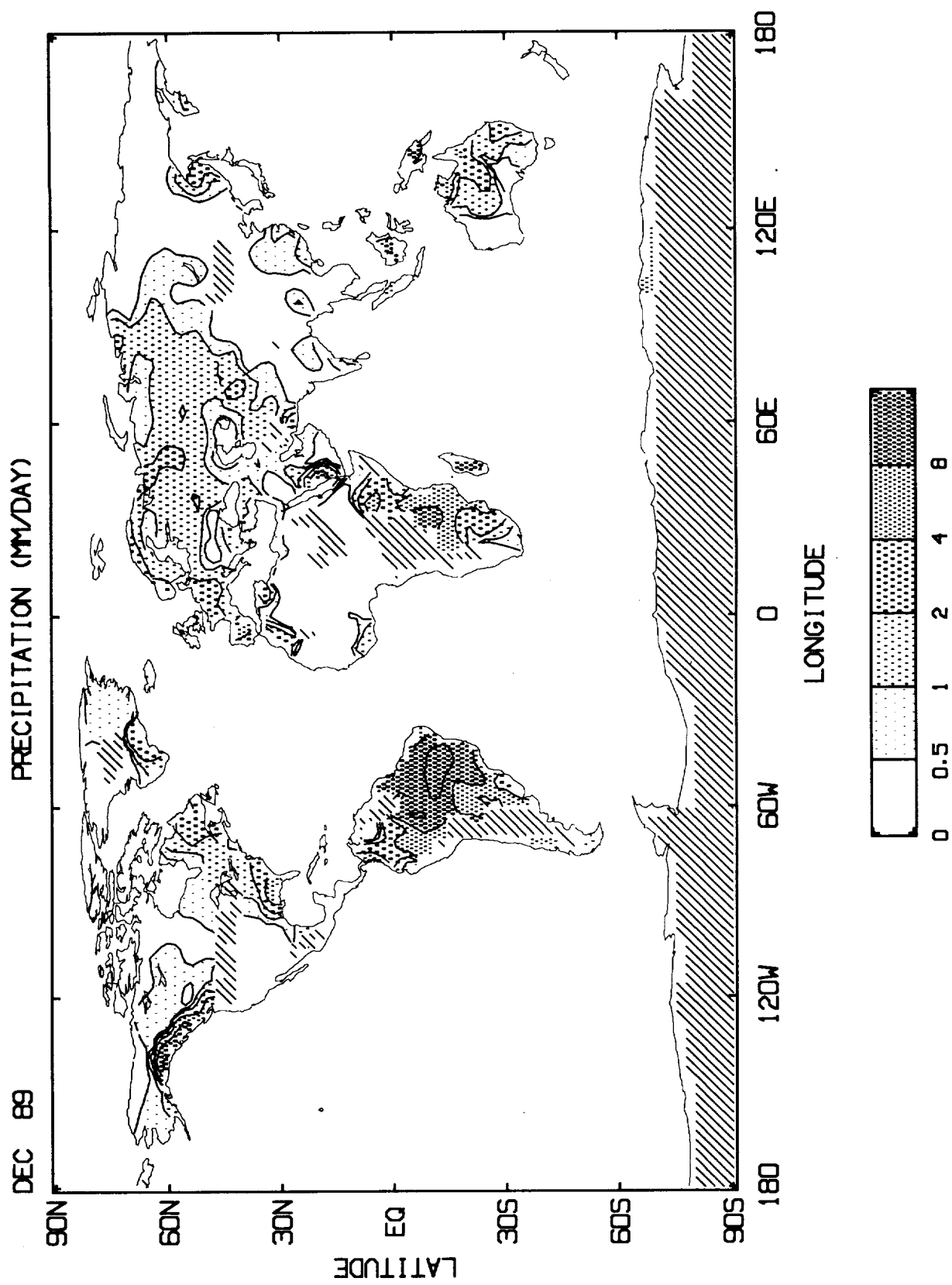


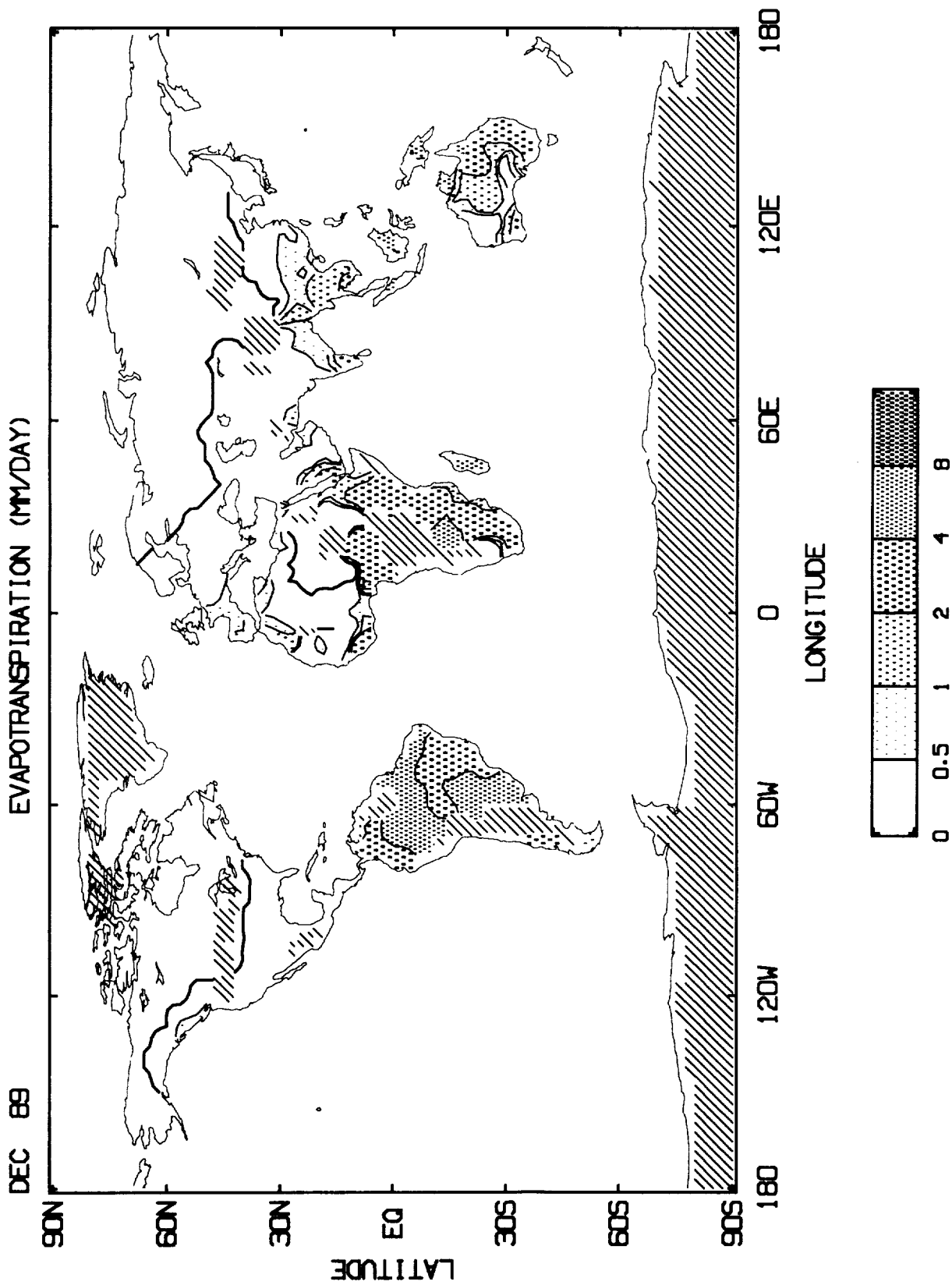












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13. ABSTRACT (Maximum 200 words) This atlas is meant to provide a convenient tool for researchers to familiarize themselves with the variability that occurs in selected climate parameters on monthly and longer time scales. The quantities are monthly means of the zonal wind and velocity potential at 850 and 200 mb, the 300-mb geopotential height, anomalies of sea surface temperature and outgoing longwave radiation, and precipitation and evapotranspiration, for the years 1985-89. The format of the document has been chosen to help facilitate the intercomparison of various parameters and to highlight the year-to-year variability in monthly means. The data are from a number of different sources.				
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